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Grids of the future

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Brussels delays rules on green hydrogen but countries still press ahead

As Brussels continues to debate the rules around hydrogen production, individual countries are pressing ahead with efforts to grow the nascent hydrogen economy. **Junior Isles**

The European Commission's ongoing delay of the release of 'additionality' rules that will set the requirements for renewable hydrogen is seen as an obstacle to the ramping-up of the bloc's nascent hydrogen market.

It was expected that a draft of the rules would be released in mid-December but there was no further news as the year drew to a close.

According to a draft document seen and published by *EURACTIV*, additionality rules are needed to ensure that renewable hydrogen is produced at times and at places where renewable electricity is available. "Until 31 March 2028", this approach will largely be discarded, the draft shows.

According to the draft rules, there should be a quarterly correlation between renewable generation and hydrogen production and a geographical correlation in terms of being located in the same electricity bidding zone. Think-tanks and activists are more in favour of an hourly or daily correlation.

Modelling shows that an hourly correlation between renewable electricity production and hydrogen production from grid-drawn electricity will keep related carbon emissions in check. Rather than running 24/7, electrolysers would run during hours that wind and solar PV plants feed renewable electricity into the grid.

The geographical correlation will similarly be fulfilled if electrolyser and renewable generation are in the same electricity bidding zone. This plan is far less ambitious than initial expectations.

Commenting on the draft, an expert told *EURACTIV* that the delegated act is a "perfect compromise" that hurts all sides "just enough."

The EU Renewable Energy Directive obliges the European Commission to define the term "renewable" hydrogen through a Commission "Delegated Act". Until Europe's power system is primarily decarbonised, the EU must put safeguards to ensure that hydrogen produced via electrolysis is in line with the Green Deal.

Brussels is also believed to be studying the establishment of scenarios in which hydrogen production from fossil fuels can be considered "fully renewable" for the next four years in a move aimed at increasing hydrogen production in the near-term. The rules would qualify the production of renewable liquid and gaseous fuels of non-biological origin, as well as the resulting fuel, as fully renewable until December 31, 2026.

The energy sector, however, is pressing ahead with efforts to grow the green hydrogen economy, with several key projects being announced in recent weeks.

Last month Germany's National Hydrogen Council presented a roadmap

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Carbon emissions carving out international borders

Domestic laws on green energy and carbon emissions, aimed at supporting the global effort to address climate change, are threatening to create trade divisions between countries.

In December the United States and European Union agreed to intensify talks to resolve EU concerns over major subsidies for American companies contained in a US clean energy law.

Although no deal was reached at a meeting of the bilateral Trade and Technology Council (TTC) last month, the two sides pledged to continue work on preliminary progress and said they would push for a solution that benefits both US and European firms, workers and consumers as well as the climate.

"We acknowledge the EU's concerns and underline our commitment to address them constructively," the two sides said in a joint statement after the meeting at the University of Maryland in College Park, located just outside Washington.

"We underline the TTC's role in achieving this and in supporting a successful and mutually supportive green transition with strong, secure, and diverse supply chains that benefit businesses, workers, and consumers on both sides of the Atlantic," it said.

The dispute revolves around the US Inflation Reduction Act (IRA), which offers about $375 billion in new and extended tax credits to help the US clean energy industry as well as buyers of qualifying electric vehicles made in North America.

But European leaders have expressed alarm that the subsidies would be an enormous setback for European companies. French President Emmanuel Macron raised the issue directly with President Joe Biden during his recent state visit to Washington during which Biden and other US officials said they were willing to address the matter, including "glitches" in the law.

Meanwhile, EU lawmakers have agreed to introduce the world's first carbon border tax with the aim of raising environmental standards globally and protecting its domestic industry, despite concerns that the plans could breach WTO rules and spark trade disputes.

Under the carbon border adjustment mechanism (CBAM), importers will have to buy permits for their carbon emissions at the same price paid by domestic producers under its emissions trading system.

Mohammed Chahim, a socialist MEP who led the negotiations for the European Parliament, said the agreement would be "a crucial pillar of European climate policies", adding, "it is one of the only mechanisms we have to incentivise our trading partners to decarbonise their manufacturing industry."

The CBAM is designed to protect against "carbon leakage" – the risk that EU industries could outsource manufacture of goods for the domestic market to regions with lower environmental standards, ultimately leading to deindustrialisation in Europe.

Tax credits for green technologies under the US' IRA has added to those concerns.

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with actions that need to be taken in order to ensure enough storage capacity for hydrogen and support the transition from natural gas to a hydrogen economy.

The paper was published as Germany's economy ministry completed a draft strategy paper that reveals plans to develop an 1800 km hydrogen energy pipeline network by 2027 with state participation. The paper, seen by *Reuters* also envisages Germany fostering the use of blue hydrogen and importing it during a transition period towards green hydrogen.

The creation of a hydrogen network company with state participation was needed to build a system that was both fit for purpose and affordable, the paper said. The government is expected to present its plans to industry shortly. The government also envisages Germany doubling its electrolysis capacity to 10 GW by 2030, the paper said.

Spain has also recently announced plans that will accelerate green hydrogen production and prepare for transport of this future energy sources across the EU.

Following a meeting in December with the leaders of France and Portugal and European Commission President, Ursula Von der Leyen, Spain's President, Pedro Sánchez revealed the cost of plans for a green hydrogen corridor between Spain and France.

Von der Leyen expressed full support for hydrogen

The new submarine hydrogen pipeline between Barcelona and Marseille (BarMar) will cost an estimated €2.5 billion and link the Iberian Peninsula with France.

The new pipeline will form a significant part of the €2.85 billion H2Med project. Hailed as the first "great hydrogen corridor of the European Union", the project will interconnect the hydrogen networks of Portugal and Spain with France.

The plan is for H2Med to be "completed and operational" in 2030 to allow Spain to export 10 per cent – some 2 million tons per year – of the total renewable hydrogen consumption target estimated by the European Union.

Von der Leyen expressed the European Union's full support for a project based on hydrogen. She said the project will "change the history of Europe" and will be "a crucial part" of the EU's energy system.

"The project is clearly going in the right direction, and I welcome it to apply for EU funds. This is only the beginning, but it is a very promising beginning. The Iberian Peninsula will be one of the great energy hubs of the European Union," she said.

The first section between Celorico (Portugal) and Zamora (Spain), which will cost some €350 million, is expected to be completed in about four years, including 26 months to obtain the relevant authorisations.

The estimated execution time for BarMar is 56 months, including 26 months to obtain the permits. Construction is expected to start in 2025.

Fusion breakthrough brings commercialisation closer

The demonstration of "energy gain" for a fusion reaction is a big boost to a private sector that is becoming increasingly confident there will be commercial reactors within the next decade or two.

Junior Isles

The promise of near limitless, zero-carbon power is beginning to look less like science fiction, as private investors gain confidence following news of a breakthrough that has seen scientists achieve energy gain in a fusion reaction for the first time in history.

Last month, scientists at the Lawrence Livermore National Laboratory in California, USA, revealed that they achieved the gain using inertial confinement laser-based fusion. The test involved bombarding a pellet of hydrogen plasma with the world's largest laser to trigger a nuclear fusion reaction – the same process that powers the sun.

The gain occurred for a split second and the energy produced was only greater than that in the lasers used to trigger the reaction, and not the total electrical energy use to power the system. Researchers were able to produce 2.5 MJ of energy, 120 per cent of the 2.1 MJ used to power the experiment.

Many commentators, however, celebrated the breakthrough.

"Scientists have struggled to show that fusion can release more energy out than is put in since the 1950s, and the researchers at Lawrence Livermore seem to have finally and absolutely smashed this decades-old goal," Arthur Turrell, Deputy Director of the UK Office for National Statistics, wrote on Twitter. "This experimental result will electrify efforts to eventually power the planet with nuclear fusion – at a time when we've never needed a plentiful source of carbon-free energy more!"

The announcement is good news for a technology that has received growing interest from the private sector, which is now expected to play a huge role in bringing it to market.

"We see this as a passing of the torch moment," said Andrew Holland, Executive Director of the Fusion Industry Association, which was set up in 2018 to represent the nascent sector. "This is where it goes from the lab to the market place."

The oldest private company in the field, according to the association's most recent report, is Princeton Fusion Systems, founded in 1992. California-based TAE Technologies came next in 1998, followed by Canada's General Fusion in 2002. But most of the private sector growth has come in the past five years after the 2016 Paris climate agreement committed countries to limit global warming to well below 2°C

The breakthrough adds impetus to this growing momentum.

Zoltan Tompa, a board member of General Fusion, said: "It's a huge shot in the arm and I think it's a psychological signal to society at large, to investors, to policymakers, that fusion is no longer in the realm of science fiction. We believe it has a real shot at putting a commercial power plant on the grid within about a decade from now."

The company says it is on track to demonstrate the real-world possibilities of the clean energy technology at the power plant level by the year 2027 and have its first commercial power plant online in the early 2030s.

Some public-sector scientists suggest that such timeframes are too optimistic. But Philippe Larochelle at Bill Gates's Breakthrough Energy Ventures, which first backed Commonwealth Fusion Systems (CFS) when it was founded in 2018, said the fund's fusion investments should no longer be seen as speculative.

"The reason we've invested in CFS and our other fusion companies is that we apply the same standard to them that we do to all of our other electricity investments, which is: do we think that this is a scalable way of getting carbon free dispatchable power at less than $50/MWh," he said. "It seems like there's a very plausible pathway here that this could be a dominant source of energy on Earth, sometime this century, and I think maybe even in the next decade or two."

Although energy gain is a huge step, a similarly significant leap is still needed to get to commercialisation, notably in developing materials and components that can operate reliably over long periods. But encouraged by the breakthrough, the race is now on to build the first nuclear fusion reactor.

The US Department of Energy (DOE) believes fusion energy should be feeding the nation's power grid by 2040 and has called for applications for entrepreneurial projects under the US Energy 2020 Act, allocating a budget of $50 million.

If the companies selected for these initial grants succeed in meeting a series of increasingly rigorous scientific and engineering milestones, they could be eligible for up to $415 million more in research grants. To remain in the programme, fusion teams will have to reach a progressive series of technical milestones, demonstrating that they can solve outstanding engineering challenges.

Meanwhile, in Europe, in early December Swedish company Novatron Fusion Group AB secured investment from EIT InnoEnergy – the innovation engine for sustainable energy supported by the European Institute of Innovation and Technology (EIT) – to build a new test facility to validate Novatron's unique approach to plasma confinement.

In late November, UK-based First Light Fusion announced a technical partnership to rapidly advance towards a 60 MW pilot plant based on its unique fusion technology – a form of inertial confinement fusion using a projectile instead of a laser – while addressing the need for tritium harvesting.

Energy security is driving renewables growth, says IEA

The global energy crisis is driving a sharp acceleration in installations of renewable power, with total generating capacity worldwide set to almost double in the next five years, the International Energy Agency (IEA) says in a new report.

Energy security concerns caused by Russia's invasion of Ukraine have motivated countries to increasingly turn to renewables such as solar and wind to reduce reliance on imported fossil fuels, whose prices have spiked dramatically. Global renewable power capacity is now expected to grow by 2400 GW over the 2022-2027 period – an amount equal to the entire power capacity of China today – according to 'Renewables 2022', the latest edition of the IEA's annual report on the sector.

This massive expected increase is 30 per cent higher than the amount of growth that was forecast just a year ago, highlighting how quickly governments have thrown additional policy weight behind renewables.

The report finds that renewables are set to account for over 90 per cent of global electricity expansion over the next five years, overtaking coal to become the largest source of global electricity by early 2025.

The amount of renewable power capacity added in Europe in the 2022-27 period is forecast to be twice as high as in the previous five-year period, driven by a combination of energy security concerns and climate ambitions.

An even faster deployment of wind and solar PV could be achieved if EU member states were to rapidly implement a number of policies, including streamlining and reducing permitting timelines, improving auction designs and providing better visibility on auction schedules, as well as improving incentive schemes to support rooftop solar.

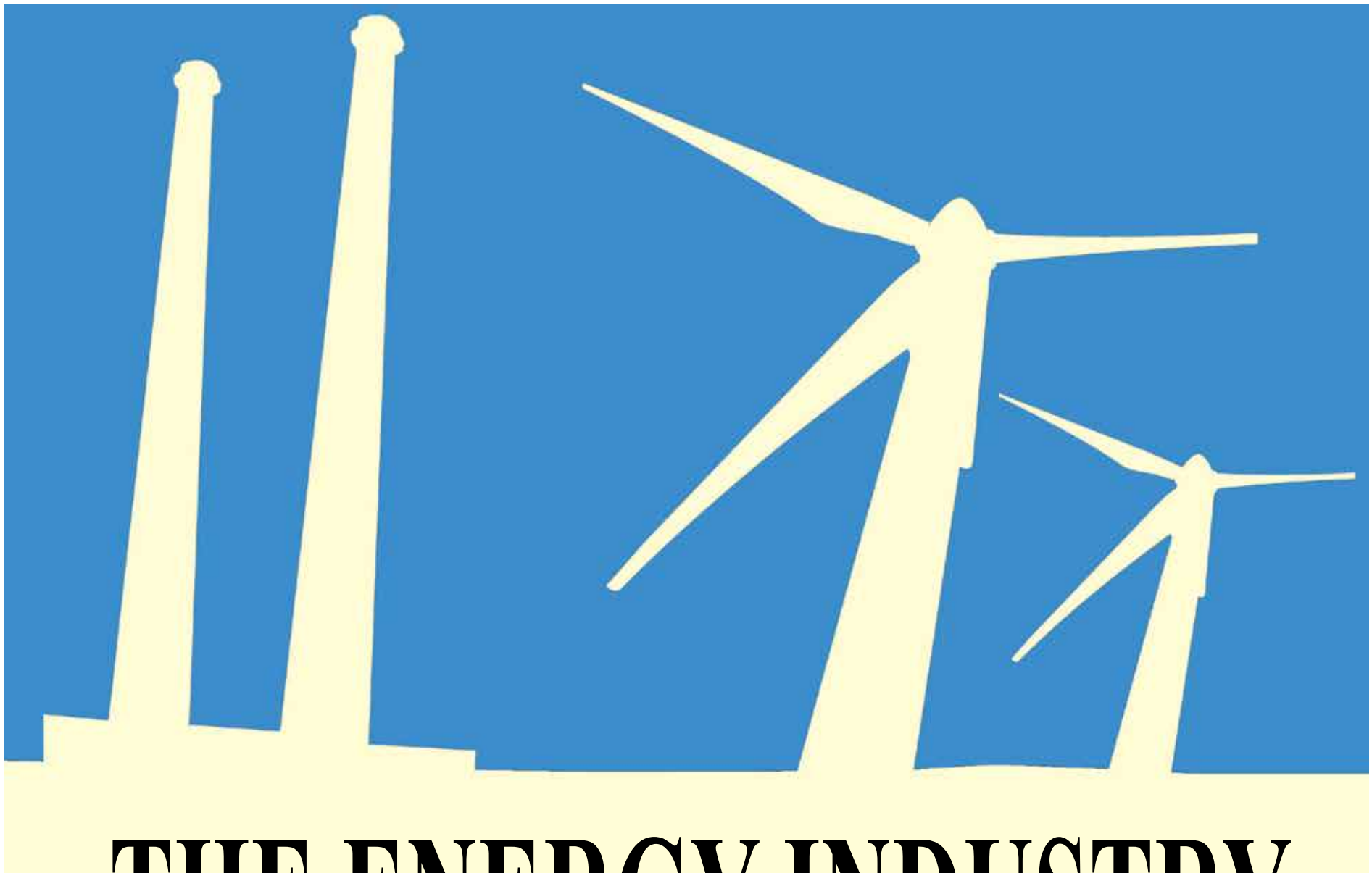
The report came as EU energy ministers agreed in principle emergency regulations that aim to speed up wind and solar permitting. Delays in environmental permitting and grid connections have slowed wind and solar growth. Permitting can take several years due to complex administrative processes and a lack of resources at approval authorities.

Net zero emissions is $7 trillion opportunity

The transition to a net zero emissions world opens up an investment opportunity that totals almost $200 trillion by 2050 – or nearly $7 trillion a year, according to BloombergNEF.

The research and analysis firm modelled a path to global net zero by 2050 and found the world can limit warming to 1.77°C. For that, "clean power deployment needs to quadruple by 2030, in addition to a major investment in carbon capture and storage, advanced nuclear technologies, and hydrogen," said David Hostert, global head of economics and modelling at BNEF and lead author of the report.

There are two scenarios highlighted in the report: an Economic Transition Scenario, that assumes no new policy action; and a Net Zero Scenario, that assumes global net zero emissions by 2050. The economic transition scenario requires annual investment to double from the 2021 level of $2 trillion per year to $4 trillion, while the net zero scenario requires annual investment to more than triple to $6.7 trillion per year.



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Brazil adds 1 GW of new generation in a month, looks for major investment

■ Renewables over half of new capacity ■ Huge scale of offshore wind ambition attracts majors

Janet Wood

Brazil connected over 1 GW of new power capacity to the grid in November, with 625 MW coming from wind, solar and hydro sources, according to Brazilian power sector regulator Aneel.

Solar farms represented 314.1 MW of the new capacity, while wind parks represented 271MW. Small hydropower plants added 40 MW. Since the beginning of the year, Brazil's power generation capacity has grown by over 7 GW across all power sources.

Including Brazil's hydro and nuclear capacity, clean energy sources represent as much as 83.16 per cent of the total produced in Brazil, the regulator noted.

Offshore wind is set to be the next major source of electricity for Brazil: at the beginning of this year, the government issued a Decree which enables offshore studies and the identification of suitable development areas.

The country's Institute for the Environment and Natural Resources (IBAMA) is now examining 71 applications for environmental investigation licences for offshore wind projects totalling 176.6 GW, including several developments of 5 GW and above. The largest is a 6.5 GW project proposed by Ocean Winds.

Many of the project sites overlap, so the total development will be below the total put forward. Brazil's Ministry of Mines and Energy is in charge of carrying out the studies, selecting the offshore wind zones and later will oversee auctions.

Most recently, submissions were filed by Monex Geracao de Energia, which is proposing a 3 GW project in Ceará and a 2 GW project in Rio Grande do Norte.

European developers are behind many of the projects, including oil and gas majors TotalEnergies and Equinor. Iberdrola's Neoenergia signed a memorandum of understanding (MoU) with the government of Rio Grande do Sul to pursue production of green hydrogen alongside offshore wind generation.

Oil and gas major Shell recently signed a technical co-operation agreement with Eletrobras that forsees co-investment in offshore wind projects in Brazil. The objective is to identify areas for a possible partnership.

"The generation of clean and renewable energy is part of Eletrobras' DNA, which, now, with its expanded investment capacity, seeks to promote the diversification of its generation matrix, constantly generating opportunities and getting to know new sources and technologies," said the President of Eletrobras, Wilson Ferreira Junior.

Pedro Jatob, Director of Generation at Eletrobras, added: "Considering that the eventual development of a project demands previous studies on the viability of potential areas for its implementation, the companies Eletrobras and Shell are interested in jointly carrying out the necessary studies."

Republican states appeal to FERC to block investor

US Republican-led states have tried to block investments in public utilities by Vanguard, arguing that the asset manager's environment, social and governance (ESG) rules for its investment would adversely affect consumers whose power is supplied by fossil fuel.

Vanguard Group wants to purchase more than $10 million in shares of public utility companies but Attorneys General from 13 states have filed a motion to the Federal Energy Regulatory Commission (FERC) requesting it block the purchase. FERC previously allowed a similarly large purchase from Vanguard in 2019.

The Attorneys General argue that allowing the asset manager's investment would be "contrary to the public interest." They said: "Vanguard's environmental mandates impose costs on its portfolio companies, and it is highly plausible that those costs are passed on to consumers directly or indirectly by hampering access to capital or foreclosing certain revenue-generating opportunities."

Vanguard told the *Washington Times*: "As an investor-owned asset manager, Vanguard's role is to promote long-term value creation for investors in our funds, leaving management and policy decisions to companies and policymakers. We look forward to working through the regulatory process". The action was led by Utah Attorney General Sean Reyes and the motion was also signed by Indiana, Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Montana, Nebraska, Ohio, South Carolina, South Dakota and Texas.

California roadmap to cut carbon allows for carbon capture

California has approved a roadmap for achieving carbon neutrality by 2045 that requires deep reforms in energy, transport and agriculture.

The plan approved by California's Air Resources Board (CARB) will see the state increase its wind and solar power generation capacity four-fold and reduce the use of liquid oil fuels by 94 per cent.

The plan also envisages the end of gas for residential and commercial buildings, which in the future will only be powered and heated with electricity.

Climate activists complained that the plan allowed for carbon capture and storage, while Catherine Reheis-Boyd, President of the Western States Petroleum Association, said: "CARB's latest draft of the Scoping Plan has acknowledged what dozens of studies have confirmed – that a complete phase-out of oil and gas is unrealistic".

Meanwhile, the Biden administration recently announced preliminary approval to spend up to $1.1 billion to help keep California's last operating nuclear power plant running at Diablo Canyon. The plant was due to close by 2025.

"This is a critical step toward ensuring that our domestic nuclear fleet will continue providing reliable and affordable power to Americans as the nation's largest source of clean electricity," Energy Secretary Jennifer Granholm said in a statement. Diablo Canyon produces 9 per cent of the state's electricity.

Funding agreed for Peru-Ecuador interconnector

The Inter-American Development Bank (IDB) has approved a $125 million loan for a 500 kV interconnector between Ecuador and Peru. The European Investment Bank is expected to contribute an additional $125 million to the project.

The 544 km line between the two countries will help strengthen regional energy integration and further progress the Andean Electrical Interconnection System initiative.

In Ecuador, the link will be owned and operated by Empresa Publica Estratgica Corporacin Electrica del Ecuador, Ecuador's state-owned power company, which will put up an additional $13.62 million in local funding.

The IDB's funds will be spent on Ecuador's side of the new transmission infrastructure, comprising 280 km of transmission lines and a new substation in Pasaje. That will take the line from the existing Chorrillos substation to the Peruvian border.

From the border the line will continue for an additional 264 km to Piura. This stretch will be financed by Peru's private sector, under a private concession contract that includes 30 years of commercial operation.

The interconnector, expected to take five years to build, will boost cross-border transmission capacity to 680 MW from the current 80 MW.

It is a step towards creating a sub-regional electricity market within the Andean Regional Short-Term Electricity Market, which was established alongside the Andean Community free trade area.

Engie's Chile renewable projects planned with storage alongside

■ Engie includes connections while Enel exits distribution
■ Electrolyser aims to kick-start hydrogen market

Janet Wood

Engie subsidiary Engie Chile has announced plans to invest $650 million in two planned renewable energy and balancing assets in Chile.

It has signed $450 million of contracts with companies in the Goldwind group to supply 57 6 MW wind turbines for the Lomas de Taltal wind farm, located in the Antofagasta region. The project will total 342 MW. A new 20 km transmission line will carry energy from the project into the National Electric System (SEN) at the Parinas Substation.

The second new announcement is a commercial agreement with Sungrow Power Supply for the supply and acquisition of a 638 MWh battery to be built alongside Engie Chile's Coya Solar PV Plant, also in the Antofagasta region. That contract totals $2 million. The battery will allow Engie to store energy from the solar farm and export it at times when marginal costs are determined by higher-cost generation technologies, thus avoiding transmission restrictions, the company said.

Separately, the company is planning to develop another wind project in the Antofagasta region and it recently submitted the Pampa Fidelia project for review to Chile's Environmental Evaluation Service.

The $645 million, 336.6 MW wind farm will also have a 291 MW battery and will include a 30 km 220 kV transmission line and substation to interconnect into the national grid. It is expected to start construction in the third quarter of 2024 and to come online in the first half of 2026.

Engie has also recently submitted plans for Pemuco, a 194.4 MW wind farm located in the Ñuble region, for environmental review and acquired a 101 MW operational wind project as the company is looking to decarbonise its portfolio in the country.

While Engie has retained its interest in the transmission industry in Chile, Enel Group has finalised the sale of its electricity transmission business in the country. Enel Chile has sold its 99.09 per cent stake to Sociedad Transmisora Metropolitana SpA (STM), controlled by Inversiones Grupo Saesa.

STM paid almost $1.4 billion for the holding, which comprises 683 km of transmission lines and 60 substations in Santiagos metropolitan area. Enel Group's current Strategic Plan focuses on core businesses in Tier-1 countries.

Meanwhile, Chile-based utility AES Andes has opened a bidding process for volumes of green hydrogen from a planned 2.5 MW electrolyser intended to kick-start the market. The company expects it will be able to produce 1000 kg/day of hydrogen in the Adelaida electrolyser, which is due to start operation in 2024.

Wealthy nations support Vietnam's shift from coal

■ Vietnam to receive $15.5 billion to move away from coal ■ Greenhouse gas to peak by 2030

Syed Ali

Vietnam has been offered a $15.5 billion package to help fund its move from coal to renewable energy, the latest in a total of $44 billion in deals aimed at shifting developing economies away from fossil fuels.

The package, like agreements reached with Indonesia and South Africa, includes $7.75 billion in public funding over the next three to five years alongside a further estimated $7.75 billion in private finance. The sum offered to Vietnam is also considerably higher, with Indonesia getting a $10 billion deal and South Africa promised $8.5 billion.

The G7 countries – the US, UK, Germany, France, Italy, Canada and Japan – plus Denmark and Norway and the EU have backed the package.

The deal will help bring forward the target year for Vietnam to peak its greenhouse gas to 2030, from a previous 2035 projection. In return for the funding, Vietnam has agreed to cap overall power sector emissions at 170 Mt/y of carbon dioxide by the end of the decade, and to generate just under half of its electricity from renewable sources by then compared with a current target of 36 per cent.

It has also pledged to establish a peak coal capacity of 30.2 GW by 2030, down from a current target of 37 GW, in a move that would limit the country's coal project pipeline.

Coal dominates Vietnam's power grid and the country is among the world's top 20 users of the fossil fuel. In 2020, about half of the country's energy requirements were derived from coal, whilst non-hydroelectric renewables accounted for only 5 per cent.

Vietnam, however, has a target of reaching net zero emissions by 2050 and is one of the signatories of the Global Coal to Clean Power Transition statement, committing to ceasing the issuance of new permits and construction of new unabated coal fired power generation projects.

UN Secretary-General António Guterres said the agreement between developed economies and Vietnam, South Africa and Indonesia were a "crucial tool" to "unlock the emissions cuts our world needs in the 2020s".

US President Joe Biden also said in a separate statement: "Today, Vietnam has demonstrated leadership in charting an ambitious clean energy transition that will deliver long-term energy security."

The country's effort to deliver on its clean energy and climate action targets received a further boost last month when the Asian Development Bank (ADB) signed a $107 million financing agreement with BIM Wind Power Joint Stock Company (BIM Wind) to support the operation of an 88 MW wind farm in Ninh Thuan province.

Meanwhile, in late November Marubeni Corporation announced that it has signed a Memorandum of Understanding (MoU) with state-owned power utility Vietnam Electricity Group (EVN), to jointly study a wide range of decarbonisation projects. These include the decarbonisation or carbon emission reduction of existing thermal power plants in Vietnam and the development of renewable energy and sustainable green energy such as biomass, ammonia, and hydrogen.

Australia makes progress on renewable hydrogen

The Western Australia (WA) government has announced the next steps for the development of the state's Renewable Hydrogen Target.

Speaking at the Australian Hydrogen conference, Hydrogen Industry Minister Alannah MacTiernan said the WA Government had made a number of key decisions on the Renewable Hydrogen Target following stakeholder consultation that opened in October 2022.

The initial target will seek to have hydrogen comprise one per cent of the southwest's electricity generation and represents an important first step in the development of a broader use-agnostic Renewable Hydrogen Target scheme.

The use-agnostic scheme will consider all potential use cases for renewable hydrogen, including transport, industrial feedstock, electricity generation, and pipeline blending.

It is expected to allow for certificates to be created for renewable hydrogen produced for any purpose, such as the replacement of grey hydrogen used for industrial purposes or road transport, allowing the market to develop and deliver hydrogen at a lower cost to consumers.

The news came as European Energy announced that it has acquired a majority stake in Austrom, a company located in Queensland, with the intention of accelerating the 3600 MW Pacific Solar Hydrogen Project in the Gladstone region.

European Energy will be doing the development work as well as managing the grid process for the Pacific Solar Hydrogen Project portfolio. Austrom secured the rights to four renewable sites covering 6000 ha near the Gladstone export hub.

The Pacific Solar Hydrogen Project is estimated to be able to produce well over 100 000 tonnes of green hydrogen a year.

"I believe the vast energy resources of Australia are not limited to fossil fuels but can reach far beyond that. Being a hub for renewable energy production, green hydrogen and e-fuels is the logical next step for our country," said Catriona Mcleod, Country Manager for European Energy in Australia.

"European Energy is now advancing wind and solar opportunities across the NEM, and as one of the frontrunners in e-fuels and green hydrogen I believe we are very well suited to accelerate the speed in which these projects can be realised."

■ The Albanese and Andrews governments, together with Wellington Shire Council, local community members, and industry have formally declared the Bass Strait off Gippsland as Australia's first offshore wind zone and awarded Major Project Status to the Start of the South offshore wind farm. The announcement supports the Andrews Labor government's nation-first offshore wind targets – Victoria aims to reach 2 GW of offshore generation by 2032, 4 GW of offshore wind capacity by 2035, and 9 GW by 2040.

India moves on cutting carbon footprint

In an effort to support the energy transition and reduce its carbon footprint, India has announced a series of policy measures.

These include: Permitting Foreign Direct Investment (FDI) up to 100 per cent under the automatic route; Waiver of Inter State Transmission System (ISTS) charges for inter-state sale of solar and wind power for projects to be commissioned by 30th June 2025; Declaration of trajectory for Renewable Purchase Obligation (RPO) up to the year 2029-30; and Setting up of Ultra Mega Renewable Energy Parks to provide land and transmission to RE developers on a plug and play basis.

Under its Generation Expansion Planning studies carried out by the Central Electricity Authority (CEA) for 2029-30, the share of non-fossil fuel based generation capacity in the total installed capacity of the country is likely to increase from around 42 per cent as in October 2022 to more than 64 per cent by 2029-30. This would reduce the dependence on fossil fuel in electricity generation and promote alternative sources of power like solar and wind.

According to a recent report by JMK Research, India is expected to add 13.6 GW of solar and about 2.6 GW of wind power in 2022.

At the same time as increasing renewables, India is looking to reduce emissions for its large coal fired base, which it still plans to operate well into the future.

Last month NTPC, India's largest power generating utility, and GE Power India, signed a Memorandum of Understanding (MoU) for the feasibility to demonstrate technologies to reduce the carbon footprint of NTPC's existing coal fired power plants.

"Carbon reduction from coal power plants is a key challenge and co-firing of low-carbon fuel will facilitate the transition towards a low-carbon energy economy and subsequently to net zero emission," NTPC said in a press release.

The MoU will explore the possibility of introducing ammonia as a co-firing fuel, and also develop, test, and demonstrate technologies that allow a total co-firing with lower carbon fuels in coal fired power plants.

Japan approves nuclear U-turn in effort to meet net zero targets

Japan has approved a plan to revive the use of nuclear energy in an effort to address electricity shortages and fulfil its net zero carbon pledges.

The U-turn in nuclear policy, first signalled by Prime Minister Fumio Kishida in August, follows softening public opposition to restarting reactors after repeated blackout scares in Tokyo this year along with rising electricity bills.

Under the new policy outlined by an advisory panel for the government, the country would "maximise the use of existing nuclear reactors" by accelerating restarts in a reversal of a post-Fukushima plan to phase out the use of nuclear power plants.

It would also extend the lifespan of nuclear reactors beyond 60 years and develop advanced reactors to replace those that are decommissioned.

The nuclear restarts is also being driven by the need to reduce carbon emissions as it struggles to meaningfully increase the use of renewable energy.

Last month a government report on energy supply and demand in fiscal 2021 showed Japan has increased its reliance on renewables and nuclear power as it tries to achieve the goal of net zero emissions by 2050.

Renewables accounted for 20.3 per cent of Japan's electricity generation, up 0.5 percentage points from the previous year, while nuclear power accounted for 6.9 per cent, up 3.0 points. The share of thermal power generation excluding biomass decreased 3.5 points to 72.9 per cent, according to the report.

"Based on the results in the report, we will continue our study of measures to secure a stable energy supply and promote 'green transformation' toward reaching carbon neutrality," Economy, Trade and Industry Minister Yasutoshi Nishimura told local reporters.

The Japanese government also announced plans last month to start a carbon pricing system for trading greenhouse gas emissions in fiscal 2026 as part of its efforts to achieve carbon neutrality.

Under the system, companies will be able to trade credits they have earned by reducing emissions.

A timetable drawn up by the industry ministry says power companies will be asked to pay emission fees starting in fiscal 2033 in an attempt to reduce the use of fossil fuels.

New projects connect hydrogen into developing energy vectors

■ Danish site will be ready for offshore wind ■ New projects link to heat, methanol, power facilities

Janet Wood

Ørsted and Skovgaard Energy have signed a letter of intent for phased development of a Power-to-X facility in Idomlund, Denmark, which is expected to be a landfall site for offshore wind in the North Sea.

Phase one will have electrolysis capacity of 150 MW and will be powered by onshore wind and solar. With offshore wind and international hydrogen the electrolysis capacity will increase to more than 3 GW.

Anders Nordstrøm, Chief Operating Officer of Ørsted P2X, said: "By partnering with Skovgaard Energy on the Idomlund project, Ørsted is entering one of the most strategically advantageous projects to leverage the strong fit between large-scale renewable energy and Power-to-X."

Separately, a Power-to-X plant will supply green district heating to 3300 households in Denmark's Aabenraa municipality, after European Energy entered an agreement with Aabenraa Fjernvarme to supply excess heat from an e-methanol plant destined to power Maersk's first fossil-free container ship.

"The collaboration will provide valuable knowledge on how we can get the most out of the world's largest e-methanol plant, and thus also show in practice how sector coupling can be made with other future Power-to-X projects," said Rene Alcaraz Frederiksen, Head of Project Economics & Optimisation, Power-to-X, at European Energy.

The e-methanol plant will be connected to a solar park in Kassø. Aabenraa Fjernvarme will establish a pipeline to the facility, sized to connect extra surplus heat from other heat sources such as data centres.

"We are happy to have contributed to this project being realised and to be a pioneering project for others in the region on how to abolish silo thinking within the energy sector and thus develop the efficient and flexible energy solutions that we need in the green transition, which is currently more urgent than ever," said Steen Brødbæk, chair of the Committee for Green Energy and Sector Coupling.

Meanwhile the Hyflexpower consortium – comprising Engie Solutions, Siemens Energy, Centrax, Artic, the German Aerospace Center and four European universities – recently announced the completion of the first stage of an industrial integrated hydrogen demonstrator project.

Hydrogen produced by an electrolyser is used in a gas turbine with a mix of 30 per cent hydrogen and 70 per cent natural gas. In 2023, trials will continue to increase the hydrogen ratio up to 100 per cent.

Ertan Yilmaz, Hyflexpower Global Director at Siemens Energy, commented: "Hydrogen-ready turbines will play a decisive role in climate-neutral energy, so it is very exciting to be looking forward to the next phase of testing."

German nuclear extension may relieve Swiss EV owners' anxiety

Electric vehicle (EV) owners could be targeted to reduce energy use in Switzerland, under a new four-step plan to prevent power cuts and blackouts, according to reports in Germany's *Der Spiegel* newspaper.

Switzerland typically imports electricity from France and Germany to help meet its power demand, but this year supply from its neighbours is constrained.

Switzerland has proposed a four-stage action plan to avoid blackouts. In the third stage among the options, driving EVs could be banned in Switzerland except for 'absolutely necessary journeys'. The country also plans a stricter speed limit on highways in the recently proposed action plan, which has yet to be adopted.

The Swiss Federal Electricity Commission, Elcom, warned of potential shortages as far back as June last year, due to a lack of French nuclear power generation. It warned that Switzerland may need to cover its electricity import needs of around 4 GWh from imports from Germany, Austria and Italy but that would heavily depend on the availability of fossil fuels – mostly natural gas.

However, the upper house of the German parliament recently said that a law allowing for continued operation of three German nuclear power plants should come into effect immediately. The Isar 2, Neckarwestheim 2 and Emsland nuclear power plants will now remain in operation until April.

Portugal loan kicks off step up in EIB green finance

Iberdrola and the European Investment Bank (EIB) have sign a €70 million green loan agreement that will help boost renewable energy development in Portugal.

The loan will finance the construction of 188 MW of solar farms, largely in rural areas.

EIB Vice-President Ricardo Mourinho Félix said the agreement, "confirms the Bank's commitment to support Europe in achieving climate targets. We are pleased to collaborate with Iberdrola in its first ever solar power plants in Portugal which will also generate economic growth and jobs in cohesion regions".

José Sainz, Iberdrola's Chief Financial Officer, explained that the agreement is in line with "Iberdrola's commitment to support the energy transition in Portugal, where we intend to triple our solar capacity by 2023".

This is the second time that the EIB has provided financing for Iberdrola's projects in Portugal, following a previous loan of €650 million for the Tâmega gigabattery hydro project.

Over the past decade, the EIB has channelled nearly €100 billion into the EU's energy sector. It recently decided to raise clean energy financing volumes to record levels to help end Europe's dependence on Russian fossil fuel imports. It agreed to invest an additional €30 billion over the next five years. The EIB Group's overall objective is to mobilise €1 trillion in climate finance.

Europe struggles to manage power prices

■ Low volumes from nuclear and hydro
■ Pushback over emergency measures

Janet Wood

Europe's governments are struggling to manage rising energy costs, driven by high and volatile gas prices and low supply, while continuing to boost a green energy sector that will reduce reliance on gas in the long term.

A new draft law in Germany will cap the cost of gas and electricity next year and force utility companies to justify any increase in price as part of a mechanism to receive other subsidies.

"We want to prevent free-rider effects that encourage utility companies to charge higher tariffs," Michael Kruse, spokesman for energy policy for the Free Democratic Party (FDP) parliamentary group, told German newspaper Bild.

Low levels of generation, including from France's nuclear plants, have also helped drive up prices. In Norway prices have increased most dramatically in the north, where they have increased five-fold as electricity producers have to tap into reservoirs that have not been topped up because precipitation is below normal.

In the UK, meanwhile, one wind farm developer has threatened legal action against the government's planned windfall tax on electricity generators.

The new Electricity Generator Levy (EGL), which came into effect on 1 January, is a 45 per cent charge on so-called 'exceptional receipts' generated electricity production. The government says renewable energy generators are 'free riding' on high prices caused by the high price of gas.

Community Windpower said it has instructed London law firm Mishcon de Reya to ensure that the Levy "is urgently amended to be fair and to better achieve the government's own objectives".It warns that the effect of the way the EGL has been designed will be to make investment in the sector "completely unviable".

The EGL came as a further set back to the UK's onshore wind industry, which had hoped to see a resurgence of projects in England after the government indicated it would soften on an effective moratorium on further development.

In response Vattenfall's Head of UK Onshore Development, Frank Elsworth, said: "If this is a genuine move which will put onshore wind on a level playing field with other infrastructure in England, it will send a very positive signal that the government is serious about harnessing the benefits which onshore development can unleash for the environment , the economy, and communities."

In contrast some UK projects – those whose payment is made under the UK Contracts for Difference scheme – have been returning cash to consumers above the 'strike price' agreed at the start of generation.

Sweden in early phase on new nuclear as Romania debates go-ahead

Sweden's Fortum and Electricite de France (EDF) have signed a Framework Cooperation Agreement to explore collaboration opportunities for both small and large nuclear reactors in Finland and Sweden.

The agreement is part of Fortum's two-year feasibility study exploring prerequisites for new nuclear in Finland and Sweden.

Petra Lundstrm, Fortum's Vice President for Nuclear Engineering Services and Co-owned assets, said: "We are very happy to cooperate with the leading nuclear company in Europe both within the scope of our recently launched Feasibility Study regarding new nuclear in the Nordics, and with the objective to learn about the advanced fleet approach from EDF."

The agreement is several steps away from agreeing any new project.

In Romania, in contrast, the government has debated a new law that would allow for two new 700 MW reactors at the Cernavoda nuclear site.

"It is a very important law, which I hope will be adopted as soon as possible by my colleagues in the Parliament, in order to move forward with the project of the new units from Cernavoda," Energy Minister Virgil Popescu said.

If agreed, the new reactors could start operations in 2030 and 2031.

Hydrogen and storage firm in African green power deal

■ Waste-to-hydrogen firm to support solar deployment ■ Project rollout to begin in early 2023

Nadia Weekes

H2-Industries, a global hydrogen generation and energy storage solutions company, has signed a Memorandum of Understanding (MoU) to support Swiss developer Terra Sola in building large-scale solar energy programmes across Africa.

The projects will use H2-Industries' liquid organic hydrogen carriers (LOHC) technology, allowing the storage and release of electrical power for export, local use in industry, grid stability or off-grid power availability.

H2-Industries' technology relies on converting waste into hydrogen for transport as a carrier fluid referred to as LOHC, which can be stored in tanks.

The multi-million US dollar cooperation aims to accelerate the transition of local industries to renewable energy while boosting socio-economic development in the selected countries. Plans for several projects are in the final negotiation stages with the respective government authorities, with initial implementation expected in the first quarter of 2023.

Terra Sola is already active in more than 17 African countries through its Algeria-based development arm Terra Sola PV Production Algérie.

"African countries feature a promising combination of resources, favourable locations and committed administrations, positioning the continent as an ideal place for generating renewable energy and for becoming the potential hub for the hydrogen-based global economy," said Belkacem Haouche, General Director of Terra Sola Algérie PV Production.

"Clean energy transition is a once-in-a-lifetime opportunity for Africa, a chance to reduce poverty and lift growth potential," said Michael Stusch, CEO of H2-Industries.

In April last year, H2-Industries signed an MOU with the Public Establishment For Industrial Estates – Madayan to build a waste-to-hydrogen plant in conjunction with PV solar power plants in the Sultanate of Oman.

The proposed $1.4 billion facility is to be developed on a coastal site and will initially convert up to one million tonnes of municipal solid waste a year sourced from waste management operators and mined from existing landfills. It has the capacity to expand to manage up to four million tonnes of waste.

The project also includes the construction of a 300 MW solar PV installation that will include 70 MW of electrical storage.

Meanwhile, Seyi Sobogun, Head of Capital Projects at Egbin Power Plc, a Sahara Power Group Company, said at an energy conference in Dakar, Senegal, that Africa will need at least $190 billion worth of investments annually between 2026 and 2030 to meet its energy and climate goals while boosting socio-economic prosperity.

Sobogun noted that Africa's share of renewables in electricity generation would grow from 21 per cent in 2020 to 59 per cent by 2030. The funds would be required to drive the installation of the renewable energy facilities, as well as the infrastructure needed for transmission and storage.

Eskom head resigns as South Africa energy crisis deepens

The head of South Africa's state-owned power utility Eskom, Andre de Ruyter, resigned in December as the country's energy crisis continued to worsen.

De Ruyter, a former packaging executive who took over as CEO in 2020, will remain in his post until March 2023 to give the firm time to look for a successor, said Mpho Makwana, the chairman of Eskom's board.

"It has been an honour and privilege to serve Eskom and South Africa. I wish all the hard working people of Eskom well," said De Ruyter. Public Enterprises Minister, Pravin Gordhan, thanked De Ruyter for his "sacrifice and resilience in a difficult job".

Scheduled blackouts have affected South Africa for years, with Eskom failing to keep pace with demand and maintain its ageing coal power infrastructure. The country saw more than 200 days of load shedding in 2022, costing hundreds of millions of dollars in lost output, disrupting commerce and industry and angering the population.

Eskom, which has a debt of ZAR 400 billion ($23.3 billion) – half of which the government has pledged to take on – has said it is unable to buy diesel to stabilise the system.

In December, amid rolling blackouts and allegations of sabotage and corruption, the government stationed members of the armed forces at several power stations. It also apologised for the prolonged energy crisis. "We apologise to the country about the impact and disruptions," Gordhan said.

"Power cuts are having a devastating effect on households and livelihoods, investment and economic climate. This is totally unacceptable."

The opposition Democratic Alliance (DA) party warned of the growing risk of a national blackout due to system failure and called for a contingency plan.

Meanwhile, the government of neighbouring Zimbabwe has announced the removal of barriers to power generation investments. President Emmerson Mnangagwa said he would take extraordinary measures to avoid the continuation of power shortages caused by low water levels at the Lake Kariba hydropower plant and repeated breakdowns at the Hwange Thermal Power Station.

According to energy experts, the government should remove the obligation on investors to charge sub-economic tariffs in order to attract investment in new power stations.

"So many projects have been licensed, but they have not been commissioned," an expert said. "As long as the state power utility ZESA Holdings wants to pay for the power in local currency, there will be problems," he added.

Chinese company Sinohydro is installing two new generators at Hwange, adding another 600 MW by 2023.

Aside from hydropower generation, which has been affected by continuous droughts and changes in the ecosystem, Zimbabwe will be looking to solar, wind and methane gas, as well as imports from neighbouring countries.

Saudi Arabia to build largest photovoltaic facility in MENA

Saudi Arabia's Water and Electricity Holding Company (Badeel) and leading energy developer ACWA Power have signed an agreement to build the largest solar photovoltaic (PV) facility in the Middle East and North Africa.

The 2060 MW solar PV plant in Al Shuaibah of Makkah province is being developed by Shuaibah Two Electrical Energy Company, with Badeel and ACWA Power each owning a 50 per cent stake. The project is expected to achieve commercial operation in late 2025.

Saudi Arabia announced in September five new renewable projects – three wind and two solar – with a total capacity of 3.3 GW.

New energy storage rules boost Turkish renewables

■ Co-located storage boost for solar and wind facilities
■ Energy watchdog receives more than 900 applications

Nadia Weekes

New rules by Türkiye's energy watchdog have produced a record number of applications for storage facilities to be co-located with large-scale solar and wind energy projects.

The Energy Market Regulatory Authority (EPDK) has received 909 applications for TRY 2.05 trillion ($110 billion) worth of solar and wind-based storage facility investments, its head Mustafa Yilmaz said. The new rules grant investors who commit to installing electricity storage a pre-licence to build the equivalent capacity in solar and wind generation.

The 909 applications are for 67 GW of capacity, of which nearly 20 GW are for 334 solar-based storage projects, with the other 47 GW coming from 575 applications for wind-based storage projects.

According to Yilmaz, the high number of applicants reflects positive investor appetite. He expects up to $45 billion of investments to materialise, boosting employment and technology development, while contributing to Türkiye's energy security and grid flexibility.

Türkiye's renewable capacity accounts for over half of the country's total installed power capacity of 100 GW. As of October, hydropower stood in first place at 31.6 GW, followed by wind power at 11.3 GW and solar at 9.1 GW.

A report in June by the United Nations Development Programme (UNDP) and the International Labour Organization (ILO) suggested that Türkiye could reap huge benefits from shifting new investments from fossil fuels to renewable energy, including an $8 billion annual GDP increase, 300 000 new jobs by 2030 and an 8 per cent reduction in greenhouse gas emissions against 2019 levels.

According to the head of the Turkish Wind Energy Association (TÜREB), Ibrahim Erden, Türkiye could install 1 GW of wind energy capacity in 2023, attracting $1 billion in fresh investments.

In a separate development, Black Sea utility OREN Ordu Energy signed an agreement with Israeli company Eco Wave Power for the world's largest – and Türkiye's first – wave energy plant, with an installed capacity of up to 77 MW and an estimated cost of TRY 2.80 billion.

Eco Wave Power will build the power plant and sell the electricity it generates in accordance with an approved production quota.

In late November, President Recep Tayyip Erdoğan inaugurated the 275-m high Yusufeli hydroelectric power plant in the northern province of Artvin. He said the annual 1.9 billion MWh of energy to be produced at Yusufeli would meet the electricity needs of 2.5 million people and provide an additional TRY 5 billion a year to the Turkish economy.

Energy and Natural Resources Minister Fatih Dönmez said Yusufeli's 550 MW installed capacity represents 1.7 per cent of Türkiye's total installed hydropower, providing "development, power, production, success and stability" to the country.

Türkiye's hydropower capacity ranks second in Europe and ninth in the world.

Pressure on energy suppliers mounts

- Engie reveals hit of up to €1 billion on net profits due to windfall levy
- Shell Energy Retail received capital injections from parent company

Junior Isles

European energy companies are under growing pressure as governments tax windfall profits and soaring energy prices take their toll.

In late December, French utility Engie revealed a hit of up to €1 billion on its net profits this year from a European windfall levy on power production. It estimated that levies in France, Belgium and Italy on revenues generated by non-gas electricity producers – designed to capture "excess profits" from soaring power prices – could lower Engie's 2022 net profit by €0.8-1 billion.

Wind, solar and nuclear power producers have been affected to varying degrees by the EU move to impose windfall levies.

Commenting on the windfall tax, the company said: "Engie retains the possibility of contesting taxes that, in its view, do not comply with the legal framework and introduce unjustified discrimination between operators or energy sources, in particular in Belgium and Italy."

The EU recommended in September that additional taxes be imposed on revenues generated by non-gas power producers when market prices exceeded €180/MWh, although countries have translated the caps into law in different ways.

In the UK, under the price cap scheme introduced in 2019, the regulator puts a limit on how much power companies can charge per unit of energy, setting the profit margin allowance at a nominal rate of 1.9 per cent of earnings before interest and tax.

As revenues have risen as a result of increases in the cap – which will jump from £3549 last quarter to £4279 for typical usage from January – the amount energy suppliers can make has risen. The regulator Ofgem has therefore set out proposals to reform Britain's energy market, including changing how much suppliers can make under the price cap.

Although record-high energy prices have benefitted non-gas power suppliers, those with gas fired generation in the mix have suffered. Many energy retailers were forced to cease operations, the largest being Bulb Energy, which was placed in "special administration" in November 2021 after its co-founder and Chief Executive Hayden Wood, admitted to the Ofgem that the business could no longer withstand sharp surges in wholesale energy prices.

The company was temporarily placed into government ownership at huge taxpayers' expense before being taken over by Octopus Energy in late December.

Bulb's acquisition by Octopus has proved highly contentious with rivals Centrica, E.On and ScottishPower, calling for judicial reviews of the government's decision in October to approve the acquisition. The reviews will be heard some time this year. The companies have complained about the speed of the deal and a lack of transparency. The British government recently admitted that it is providing up to £4.5 billion to Octopus to support the purchase of the failed electricity supplier.

More than 30 UK suppliers have gone bust since the start of 2021 and many continue to face unrelenting market pressure.

Shell's household energy supply business in Britain recently said it sought cash and loans of nearly £1.2 billion from its parent company since the start of the year, highlighting the continued financial pressure on even some of the biggest electricity and gas retailers.

Shell Energy Retail said in accounts published in early December that it had received capital injections from other Shell subsidiaries of £20 million on February 14 and £177 million on March 25.

Meanwhile, last month Uniper, the crisis-hit German gas trader that owns seven UK power stations, warned shareholders it faces "possible insolvency" unless they back an additional state bailout worth more than €50 billion (£44.6 billion).

Hyundai Electric to enter offshore wind power business

Hyundai Electric, a power equipment and energy solution subsidiary of Hyundai Heavy Industries Group, is entering the offshore wind power business in partnership with GE Renewable Energy of the United States.

The company signed a strategic partnership agreement with GE Renewable Energy in December, which will see the two companies cooperate in production and sales to enter the Korean and overseas offshore wind power markets.

Hyundai Electric will be in charge of producing nacelles and generators for GE's ultra-large wind turbine Haliade-X. It will also promote the localisation of various equipment and parts.

GE Renewable Energy plans to work with Hyundai Electric in winning orders from Korean and foreign customers and help Korea achieve its national greenhouse gas reduction target (NDC).

The two companies also signed a letter of intent to establish a joint venture company that will support their order receipt efforts.

The deal will help support the Korean Ministry of Trade, Industry and Energy's recently announced plan to build a 12 GW offshore wind farm in Korea by 2030.

■ The High Court in London, UK, has ruled in favour of GE in a patent infringement dispute with Siemens Gamesa over the design of the GE Haliade-X offshore wind turbine. In its lawsuit against GE, Siemens Gamesa claimed that the Haliade-X infringed its European patent related to the use of bearings in rotor hubs for wind turbines. The court ruled that the patent is invalid and that neither the fully assembled Haliade-X nor its hub falls within the scope of claims of the patent.

Fortum and EDF to explore joint opportunities in new nuclear

A new Framework Cooperation Agreement will see Finnish energy company, Fortum, and Electricité de France (EDF) jointly explore collaboration opportunities for small modular nuclear reactor (SMR) and large power plant deployment in Finland and Sweden.

The agreement is part of Fortum's two-year feasibility study exploring prerequisites for new nuclear in Finland and Sweden.

The French energy company EDF is the largest nuclear operator worldwide with a unique experience across the entire nuclear lifecycle. It is planning to deploy a fleet of EPR units across Europe, while developing its 340 MWe NUWARD SMR at the same time.

"EDF is delighted to join forces with Fortum, a leading nuclear industry player sharing with us the same ambitions for a sustainable carbon-free energy future. With Fortum's impeccable record as a responsible nuclear operator and EDF's unmatched experience on the entire nuclear lifecycle, we will create opportunities for a successful cooperation in Finland, Sweden and across Europe," said Vakis Ramany, EDF's Senior Vice-President of Nuclear Development.

"We are very happy to cooperate with the leading nuclear company in Europe both within the scope of our recently launched Feasibility Study regarding new nuclear in the Nordics, and with the objective to learn about the advanced fleet approach from EDF," said Petra Lundström, Fortum's Vice President for Nuclear Engineering Services and Co-owned assets.

Any future decisions on possible investments will be made at a later stage.

In late November, Fortum also said it was initiating a joint study with Helen Ltd to explore the prerequisites for collaboration in nuclear power and SMRs, in particular.

The study is linked to the Fortum project announced last October to explore the prerequisites for nuclear power generation in Finland and Sweden, including the mapping of potential partner networks and cooperation arrangements.

"Because of the uncertainty in the energy markets, projects carried out in the nuclear sector in the future are most likely to happen through various cooperation arrangements," said Jukka Hautojärvi, Fortum's representative in Fortum and Helen's joint study group.

"The study being initiated with Helen regarding the prerequisites for cooperation is a great starting point not only for project mapping, but also for the partner mapping that we are doing with various parties as part of a broader look at nuclear power over the next couple of years,"

TAQA, ADNOC, Mubadala take stakes in Masdar

Abu Dhabi National Energy Company (TAQA), Mubadala Investment Company, and Abu Dhabi National Oil Company (ADNOC) have concluded a deal to become the shareholders in Abu Dhabi Future Energy Company (Masdar).

Under the binding agreements, which were signed last June, TAQA secured a 43 per cent stake in Masdar for AED3.7 billion ($1.02 billion), whereas Mubadala and ADNOC acquired 33 per cent and 24 per cent equities, respectively.

Through the acquisition, the three companies will boost Masdar's growth under an expanded mandate covering renewable power, green hydrogen, and other enabling clean energy technologies, according to a press release.

With the shareholdings, Masdar aims to attract growth opportunities around the world including, the US, the MENA region, the Commonwealth of Independent States (CIS), Asia-Pacific (APAC), and leading European countries.

Additionally, Masdar seeks to play a vital role in securing clean energy across the UAE, which is required to achieve the 2050 net zero emissions target.

Masdar plans to produce at least 100 GW of renewable energy globally by 2030, mostly from wind and solar technologies. The company also intends to develop over 200 GW of renewable energy capacity to bolster its global position in the renewable energy sector.

Sultan Ahmed Al Jaber, Managing Director and Group CEO of ADNOC, as well as Chairman of Masdar, said: "Masdar's clean energy powerhouse will unlock a new chapter of growth, development, and opportunity for renewable energy and green hydrogen projects, both in the UAE and worldwide."

Americas

Cummins to supply 35 MW electrolyser system

Cummins will supply a 35 MW proton exchange membrane (PEM) electrolyser system for Linde's new hydrogen production plant in Niagara Falls, New York, USA. Once commissioned, Cummins' electrolyser system will power Linde's largest green hydrogen plant in the USA.

The electrolysers will be powered by hydropower, and the system will have the capability to scale up output as required.

Linde is a global leader in the production, processing, storage and distribution of hydrogen. It has the largest liquid hydrogen capacity and distribution system in the world. The company operates the world's first high-purity hydrogen storage cavern plus pipeline networks, totalling approximately 1000 km globally.

Wind turbines for Brazil

Sixteen N163/5.X wind turbines for the 94.4 MW EOL TODA Energia 2 wind farm have been ordered from Nordex by Toda Investimentos do Brasil.

The wind farm will be built near Pedro Avelino, in the state of Rio Grande do Norte. Installation is scheduled for Q2 2024.

TransWest Express selects Siemens Energy for HVDC

TransWest Express has selected Siemens Energy to supply the HVDC transmission technology for the TransWest Express transmission project in the USA.

The TWE Project is a 732-mile HV inter-regional transmission system with HVDC and HVAC segments that will connect to the existing grid in Wyoming and Utah as well as directly to the ISO controlled grid in southern Nevada.

Under a Preferred Supplier Agreement signed in November, TransWest and Siemens Energy are partners on the final design, specifications and other technical elements of the HVDC converter stations to be located in Carbon County, Wyoming, and in Millard County, Utah.

Hitachi Energy to link Canada and USA

Hitachi Energy announced in December that it was selected by Hydro-Québec for an HVDC link between the Quebec electricity network in Canada and New York state, USA.

The Châteauguay HVDC system will enable the transmission of up to 1500 MW between the electrical networks of Quebec and the state of New York, which will contribute to maintaining a low carbon footprint in the region. This new system will replace existing equipment, which has been in operation since 1984, increasing efficiency and controllability, plus raising the power conversion capacity of the Châteauguay HVDC system by 50 per cent.

Hitachi Energy is supplying a "back-to-back" converter station, enabling the interconnection of the 735 kV Canadian and 765 kV New York grids which are out of phase and cannot be connected directly via traditional AC systems.

Asia-Pacific

Preferred supplier chosen for MunmuBaram

MunmuBaram, a joint venture between Shell and HEXICON, has chosen Vestas as preferred turbine supplier for the 1.3 GW MunmuBaram floating offshore wind project in South Korea.

Vestas will supply and install 84 units of the V236-15.0 MW turbine for the project, located off the southeast coast of South Korea. The turbines will be installed on floating foundations with water depths ranging between 120 and 150 m. This will mark the first announced large-scale floating offshore project for Vestas, and the first announced project of V236-15.0 MW for installation on floating foundations.

Once installed, Vestas will also deliver 20-year service and maintenance for the wind farm.

Nepal calls for 400 kV transmission line bids

Millennium Challenge Account Nepal (MCA-N), the Nepal-based agency of the Millennium Challenge Corporation (MCC) of the US, has announced a global tender to construct 315 km long transmission lines.

The MCA-N has divided the total construction into three sections for this purpose.

A 400 kV transmission line will be constructed along Lapsiphedi-Ratamate-New Hetauda measuring 117 km. Similarly, a 90 km long 400 kV transmission line in Ratamate-Damauli and a New Damauli-New Butwal segment will also be expedited under the project.

Mingyang wins 700 MW offshore wind order

Chinese wind turbine manufacturer Mingyang Smart Energy has won the bids from China General Nuclear Power Group (CGN) for two sections totalling 700 MW of the 1 GW Fanshiyi 1 offshore wind farm in Yangjiang, Guangdong, China.

The Fanshiyi offshore wind farm is located 60 km off the coast in an average water depth of 40-48 m.

Mingyang will supply 50 of its 14 MW MySE 14-260 offshore wind turbines, to be delivered in Q3 2023.

The scope of the supply includes wind turbine equipment, towers and related services, special tools, spare parts, and consumables within the warranty period.

CGN plans to develop the Fanshiyi project in two phases, Fanshiyi 1 and Fanshiyi 2. The wind turbine tender relates to the 1 GW Fanshiyi 1 phase. Goldwind has reportedly secured the order for the remaining 300 MW section.

Europe

Finland's first large-scale offshore wind farm

Vattenfall has won an order for Finland's first large-scale offshore wind farm, which will be built and operated near Korsnäs, off Finland's west coast, and is due to be commissioned in the early 2030s.

The €1 billion project involves cooperation with the Finnish forestry company Metsähallitus.

Vestas wins European wind orders

Vestas has also won an order for the 126 MW Bord na Móna Derrinlough Wind Farm Project in Ireland. The order includes 21 V150-6.0 MW EnVentus wind turbines with a site-specific hub height of 110 m for a site in County Offaly, located in the Irish midlands. The order includes supply, installation, and commissioning of the turbines, as well as a 20-year service agreement. Delivery and installation are expected in Q1 2024 with the commissioning scheduled for Q3 2024.

In addition, Vestas has won a 37 MW order for the supply and installation of six V162-6.2 MW wind turbines with a 10-year service agreement for a wind farm in Italy. Turbine delivery is expected by Q3 2023 and commissioning is planned by Q4 2023.

Vestas has also won a 59 MW order for an undisclosed wind project in southern Sweden. The order includes a total of 13 V150-4.5 MW wind turbines at a hub height of 105 m. Delivery and installation of the wind turbines are schedules for Q2 2024, with commissioning in Q3 2024.

Finally, Vestas won a 62 MW order from Norvento Enerxia for several wind farms to be located in Galicia, Spain. The contract includes supply and installation of thirteen V150-4.5 MW wind turbines and a V136-3.45 MW wind turbine. The blades will be manufactured at Vestas' factory in Daimiel, Ciudad Real, Spain. Turbine delivery is scheduled by Q3 2023.

Sizewell C construction agreement signed

An early framework agreement has been signed between Nuclear New Build Generation, a company owned by EDF and the UK government, and Framatome for the construction of the 3.2 GW Sizewell C nuclear power station in Suffolk, England.

The early framework agreement covers specific activities, including manufacturing of the nuclear steam supply systems, managing obsolescence of I&C systems, and early engineering and procurement activities. The agreement also covers work completed since 2021 to prepare long-lead forging components and engineering.

Reserve power for Ireland's ESB

GE Gas Power and Mytilineos have secured an order from the Electricity Supply Board of Ireland (ESB) for the construction of a new gas fired power plant in Dublin, within ESB's existing North Wall Power Plant.

The new temporary reserve power plant will be powered by 6 GE LM2500XPRESS gas turbines delivering a combined capacity of 200 MW to help meet the electricity demand and help ensure stability of electricity supply in Ireland. GE and MYTILINEOS will work together for construction and O&M of the plant.

The temporary reserve power plant installed in Dublin will have natural gas fuel capability and can operate on blends of hydrogen fuel in the future. The Dry Low Emissions (DLE) combustor configuration will allow up to 35-50 per cent by volume of hydrogen when blended with natural gas.

The additional temporary emergency generation will not be available to the open electricity marketplace; instead, it will only be operated in the case of shortage of capacity.

The compact LM2500XPRESS units for this project will be manufactured at GE Gas Power's Manufacturing Excellence Centre in Veresegyhaz, Hungary.

GE to increase German transmission capacity

GE Renewable Energy's Grid Solutions has signed a contract with German transmission system operator TransnetBW for a turnkey solution to redesign the Pulverdingen 380 kV substation in the vicinity of Markgroningen, near Stuttgart.

GE's Grid Solutions team will design, produce, supply and commission 26 bays of 380 kV air-insulated switchgear (AIS) with associated buildings and control cabinets. Also in the plan is a 380 kV cable connection between the 380 kV/220 kV transformer and respective 380 kV switch panel.

The overhead line connection to the substation will be executed in three phases. The erection of temporary overhead lines for several years is required in some cases to ensure safe operation of the switchgear during the construction period. Construction work is scheduled for completion by the end of 2033.

International

Saudi energy storage system from Sungrow

Sungrow of China has signed an MoU with Saudi Arabia-based ACWA Power to supply a 536 MW/600 MWh energy storage system for the Giga project in Neom city.

In addition, Sungrow and ACWA Power also signed a strategic cooperation agreement to encourage collaboration between China and Saudi Arabia in the clean energy industry. This will also raise the contribution of both countries to China's Belt and Road Initiative and the Saudi Vision 2030, respectively.

AMEA Power wins 120 MW solar project

AMEA Power has won a contract for a 120 MW solar PV project in South Africa as part of the Sixth Bid Submission Phase of the Renewable Energy IPP Procurement (REIPPP) Programme. The Doornhoek PV Project will sell electricity to Eskom under a 20-year PPA.

AMEA Power is the majority shareholder in the $120 million project and has partnered with a consortium wholly-owned by African women, formed by Ziyanda Energy and Dzimuzwo Consulting.

The project is near Klerksdorp in the North West Province. It will generate over 325 GWh.

Construction of the Doornhoek PV project will start by mid 2023.

CHP plant for Nigeria

An agreement has been signed in which Bergen Engines will supply a 120 MW CHP plant in Nigeria. The project will provide heat and power to a major new industrial complex and its surrounding area in the Calabar region of Nigeria's Cross River State.

The 120 MW plant will comprise of ten 12 MW Bergen B36:45V20 gas engines fitted with Marelli Motori alternators. Each generator set will weigh over 175 tonnes.

Eksim orders Nordex wind turbines

Eksim Yatirim Holding has ordered 150 MW from the Nordex Group to extend two wind farms in Turkey.

Nordex will supply 22 N163/6.X turbines as part of the extension of the existing Geyve and Silivri wind farms. The two orders also include a 10-year service contract.

The Geyve wind farm, in the province of Sakarya near the Black Sea, is having its 50 MW capacity expanded by a further 98 MW with the addition of 14 1N163/6.X turbines. The Silivri wind farm near Istanbul currently has a capacity of 63 MW; Nordex will add eight 6.X turbines, bringing the total capacity to 115 MW.

The Geyve expansion will be operational by the end of 2023, and the Silivri expansion in 2024.

Hydrogen

Europe moves ahead with hydrogen infrastructure projects

While many European countries are scrambling to secure sufficient gas supplies to see them through the winter, European companies and organised bodies have not forgotten that there is another problem out there demanding that they look further ahead. Numerous efforts on how to produce hydrogen effectively and cheaply are widespread, but so are projects on how to move it and store it.

Gary Lakes

Global warming, climate change and the need to develop and expand the use of renewable energies continue to occupy the minds of world governments, scientists and businesses even though current events have prompted the energy sector to remain focused on hydrocarbon production and procurement. However, climate conditions demand that the switch to renewables be made and to that end Europe is moving forward with projects meant for a new energy era.

In the UK, Scotland-based SSE announced last month that it has begun developing an underground cavern for the storage of hydrogen in east Yorkshire. The cavern will stockpile hydrogen for use when freezing and windless conditions make wind-generated electricity unavailable.

The new storage facility will produce hydrogen through renewable energy driving a 35 MW electrolyser (green hydrogen). The storage cavern is a mile deep into the ground along the coast of Aldbrough and hydrogen stored there will power a turbine connected to the power grid. The system will be used during periods of high demand.

The project is scheduled to be completed by 2025. By 2028, SSE and Norwegian partner Equinor are to start work on a larger hydrogen storage facility near the same site. The Scottish and Norwegian power companies are co-owners of the Aldbrough Gas Storage facility, which came into use in 2011. That facility has nine underground storage caverns, each the size of London's St. Paul's Cathedral.

SSE, which operates a large renewable energy division, maintains that hydrogen storage will be vital in creating a large-scale hydrogen economy in the UK and Ireland by balancing the overall energy system by providing backup where large proportions of energy are produced from renewable power.

Meanwhile, a recent report prepared by the trade association Hydrogen UK says that unlocking infrastructure investment for 3.4 TWh of large-scale hydrogen storage is urgently required. The report – 'Hydrogen Storage: Delivery to the UK's Energy Needs' – recommends that a long-term regulated business model for large-scale storage be designed by 2025.

Noting that the UK government's Energy Security Strategy targets hydrogen reaching domestic production targets of up to 10 GW by 2030, the trade association's report stresses that building storage infrastructure simultaneously with production capacity is key to ensuring that hydrogen can deliver affordable low-carbon energy and economic growth.

Hydrogen UK CEO Clare Jackson said: "This report highlights the importance of policy and investment in hydrogen infrastructure to ensure the UK is on track to meet both its Net Zero target and energy security needs."

In the report, Hydrogen UK urges the government to design a long-term regulated business model for large-scale storage no later than 2025; launch interim measures as soon as possible to unlock final investment decisions before the finalisation of the business model, as well as a short-term business model; and create a strategic planning body to facilitate coordination between production, network and storage infrastructure.

Further east, Nordic, Scandinavian and Baltic companies have signed on to a project to develop and operate a 5000 km hydrogen pipeline transmission system that would connect the region by 2030, *Euractiv* reported.

Last month, Gasgrid Finland, the state-owned transmission system operator, the Swedish gas TSO Nordion Energi and Danish companies OX2 and Copenhagen Infrastructure Partners launched the Baltic Sea Hydrogen Collector (BHC).

This followed the signing of a cooperation agreement on the Nordic-Baltic Hydrogen Corridor, a hydrogen infrastructure system extending from Finland through the Baltics and Poland to Germany. Gasgrid Finland, Estonia's Elering, Latvia's Conexus Baltic Grid, Lithuania's Amber Grid, Poland's GAZ-SYSTEM, and Germany's ONTRAS are all parties to the agreement.

The *Euractiv* report said the BHC is meant to use offshore wind potential in the region and create an efficient, harmonised and integrated hydrogen market in Europe. The project should boost investments in the hydrogen value chains and enhance decarbonisation and green industrialisation in the Nordic, Baltic and Central European states. Once complete, the hydrogen transport system would supply industries and consumption areas throughout the region and reduce the use of hydrocarbons. A feasibility study on the plans will be carried out next year.

By 2030, it is expected that the BHC and the Nordic-Baltic Hydrogen Corridor will be connected along with the Finnish-Swedish Nordic Hydrogen Route, a project established earlier this year in Bothian Bay. Combined, the projects are seen as moving northern Europe towards a net-zero era.

Gas

Australian LNG industry fumes at hint of gas export, price controls

Australia is one of the largest LNG exporters in the world, but the bulk of its resources are off its northwestern coast, far from the population centres of the eastern central and southeastern coasts where energy demand is greatest. With the international gas market in disarray and prices going through the roof, a plan by the country's government to make Australian gas producers deliver gas to the domestic market at an affordable price has set off something of a bruhaha within the industry.

Gary Lakes

"Marxist power grab!" "Soviet-era policy." "Hasty." Such are some the words that the Australian LNG industry has hurled at the centre-left government of Prime Minister Anthony Albanese for its decision to introduce laws that could direct the gas giants to sell uncontracted natural gas to the domestic market at A$12/GJ (around $8.50/million Btu) during the next year.

The industry warns that any attempt to cap profits could interfere with contracted export volumes (most of which go to Japan, Korea and China) and harm investments which they argue are crucial to sustain sufficient resources to maintain the export industry – and the domestic market as well.

Australian gas producers sell only about 20 per cent of their product on the domestic market and the A$12/GJ price is above the historic gas price and the cost of production, according to media reports emanating from Australia. But exporters are earning five times and more than that price on the international market, where LNG cargoes are hard to find, leading Japanese analysts several weeks ago to declare the market is booked solid for the next couple years.

The steps taken by the Albanese government are designed to protect consumers in an era when domestic scarcity and price rises have been predicted by a government agency. The Australian Competition and Consumer Commission (ACCC) issued a report last summer saying the country could face gas shortages and steep price hikes in 2023 and 2024. The agency suggested that the government invoke the 2017 Australian Domestic Gas Supply Mechanism (ADGSM), which allows the government to direct gas originally meant for LNG export to be diverted for domestic supply.

With domestic prices predicted to rise by 40 per cent by 2024, energy ministers in Australian states urged energy policy reform and that gas output to be directed to the domestic market at competitive prices in order to avoid the predicted high prices and shortages. When the government passed the new laws, it triggered the gas industry to warn of dire consequences, although an 80 per cent majority of Australians are reported by the media to support the government's moves.

Analysts backing the government said the industry's reaction was "hyperbole", and Industry Minister Ed Husic said the government is taking action in the national interest and that gas executives wanted to "hold on to every single dollar of their Putin profits".

The crisis in the gas market exploded when Russian President Vladimir Putin invaded Ukraine in February 2022 causing a global disruption in hydrocarbon supplies and an eruption in energy prices.

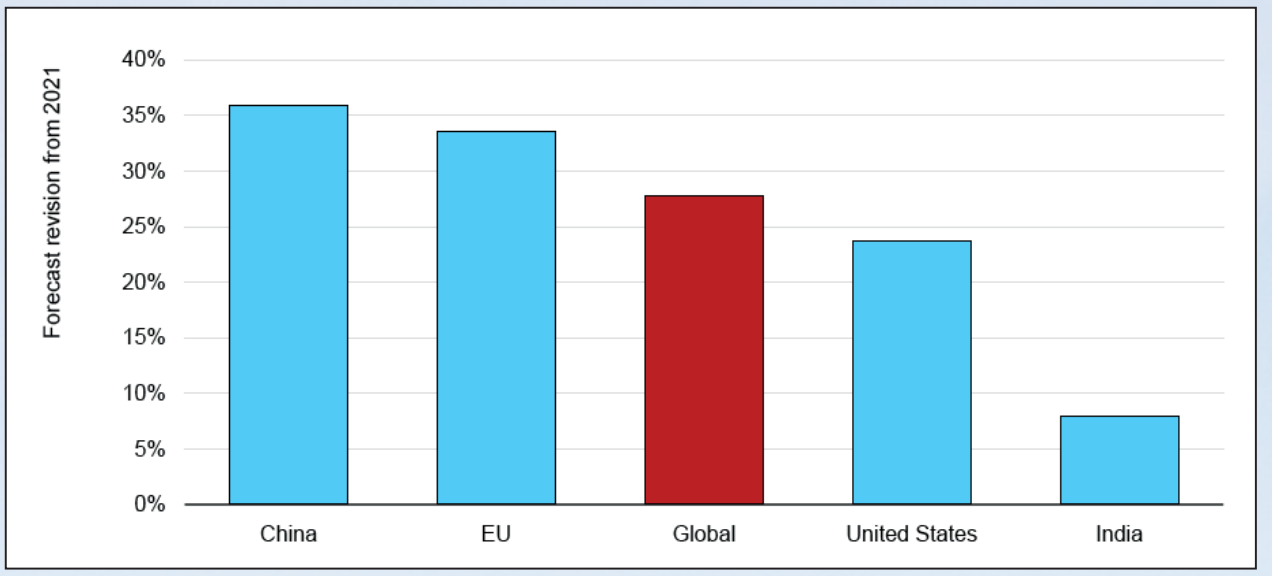
Along with Qatar and the US, Australia stands in that group of largest exporters, and considerable profits have been made. A report by Bloomberg last month said the country's LNG sector is an increasingly important part of the Australian economy. It said exports of LNG more than doubled to A$70.5 billion in 2021-22 and are forecast to rise to A$90 billion in 2022-23. With LNG accounting for 3 per cent of GDP, it is unlikely that the prime minister's government would take any step that would negatively impact the sector's investment or revenue.

There are three key LNG exporters on Australia's northeastern Queensland coast, and those companies would likely be the most affected by the new legislation since they are nearest to the population centres. The price cap would keep all of Australia's producers on an even keel with contracts, but it is unclear what impact this could have on any Australian cargoes appearing on the spot market. This could very well be the cause of the industry's ire.

The Queensland located companies: Gladstone LNG facility (owned by Santos, Petronas, TotalEnergies and Kogas); Australia Pacific LNG (owned by Origin Energy); and Queensland Curtis LNG (owned by Shell) exported some 13.24 million tons of LNG during the first half of 2022. Those companies are expected to be producing and processing more natural gas than they require to fulfill their contracts.

The three facilities have been in talks since September with Federal Resources Minister Madeleine King on an agreement that will secure energy supplies for the domestic market. How that proceeds will be determined in the new year.

Upward revisions to renewable capacity expansion forecasts from Renewables 2021 to Renewables 2022



Renewables 2022: Analysis and forecasts to 2027, Figure 1.1, page 17

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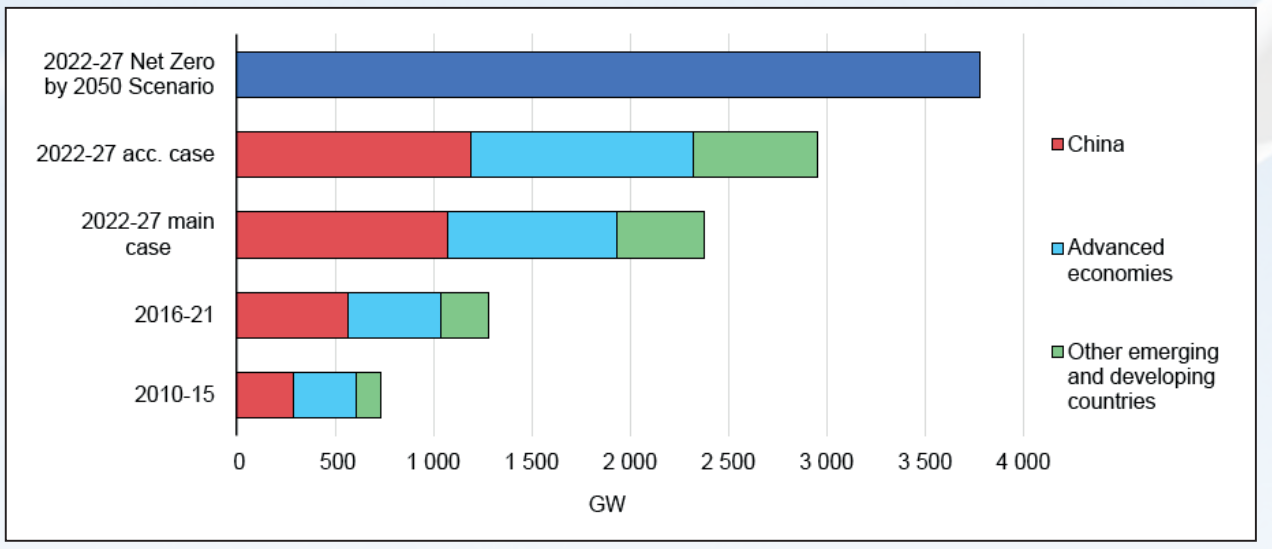
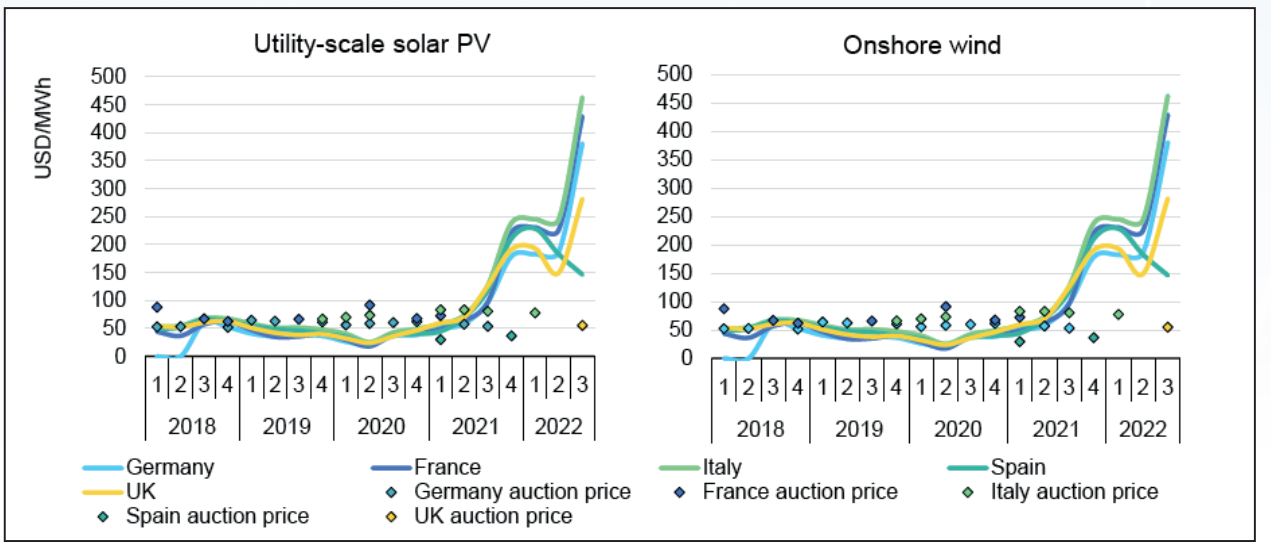
Renewable capacity growth in the main and accelerated cases, 2010-2027



Renewables 2022: Analysis and forecasts to 2027, Figure 1.2, page 18

Quarterly average utility-scale solar PV and onshore wind auction contract and wholesale power prices in selected European countries, 2018-2022



Renewables 2022: Analysis and forecasts to 2027, Figure 1.3, page 19

Grid digitalisation holds the key to a faster transition

Running a reliable grid, largely based on renewable electricity is not a pipe dream, but it is only possible with a smart, digital and decentralised bi-directional grid. Schneider Electric's Frédéric Godemel explains to **Junior Isles** how the short-term energy crisis, and the longer-term race to net zero can both be solved through implementing these grids of the future today.

The grids of tomorrow must be designed to enable global ambitions for a net zero emissions (NZE) energy system. Such a grid will not only need to handle a significant increase in the electrification of the energy system driven by renewables, but will also need to be much more flexible to integrate those renewables, as well as handling power inflows from the demand side.

Realising such systems calls for greater effort in terms of both technology implementation and policy. Some argue, however, the tools are already there to enable these grids to be implemented today, thereby significantly accelerating progress to NZE.

Explaining what a grid of the future looks like, Frédéric Godemel, EVP of Schneider Electric's Power Systems & Services Division, noted: "Achieving NZE requires much greater use of electricity compared to fossil fuels. What we see going forward is twice as much electricity flow as we have today. At the same time there will be much more renewable generation, which is more intermittent, as well as more prosumers – users that can both produce and consume electricity. The grid of the future will need to be like a [orchestra] conductor that can permanently manage demand and supply in a way that favours the maximum use of renewable energy produced from both centralised and decentralised sources. To achieve this flexibility grids have to be modernised, digitised and much more automated than they are today."

Godemel: the most implementable solution today is investment in digitalisation at the distribution grid level

A recent report from the European Commission states that the European Green Deal and REPowerEU require a deep digital and sustainable transformation of the energy system. According to the EC, the bloc needs to install solar photovoltaic (PV) panels on roofs of all commercial and public buildings by 2027 and on all new residential buildings by 2029, install 10 million heat pumps over the next five years and replace 30 million cars with zero-emission vehicles on the road by 2030.

To achieve these objectives, Europe needs to build an energy system that is much smarter and more interactive than it is today. Energy and resource efficiency, decarbonisation, electrification, sector integration and decentralisation of the energy system all require a tremendous effort in digitalisation.

The Commission estimates that about €584 billion of investment in the electricity grid will be required, between 2020 and 2030, in particular in the distribution grid. A substantial part of these investments, about €170 billion, will need to be in digitalisation.

According to Godemel, flexible digitised grid systems could allow carbon emissions to be reduced three-fold. While he says the growth in renewables – for example, through utility offshore wind in the UK, solar in Spain and growing rooftop solar in Denmark and Germany – is impressive, it is still not enough.

"Local production [of renewables] at the demand side must be multiplied by ten," said Godemel.

He added: "There must also be incredible investment in batteries to store unused renewable production. This must be increased by a factor of 100. And to connect centralised generation with the demand side, you also need to increase investment in digitalisation by a factor of five – mostly in the distribution network." This is the area of digitalisation that he believes can deliver the fastest gains.

According to Godemel, most utilities have an old generation of controllers, offering zero visibility on many parts of the network, especially at the distribution level. "This means they cannot manage balancing and load shedding at the demand side level," he noted. "The first big step in improving visibility is through the use of smart meters. They can now start to aggregate data and optimise but it's not enough; we need more investment in digitalisation."

According to Godemel, in 10-15 years much more of the grid balancing will be handled at the regional or even local level by the DSOs. Digitalisation will enable this to be done automatically.

"In the future, you can imagine a municipality in Germany balancing the local grid and simply interfacing with the transmission grid. For example, typically you are out during the day when solar is produced. So the first thing you have to do is store it for use in the evening, complementing what you need from the grid. So for zero [emissions], there is a total disconnect between the local production and the usage. To move to net zero, you probably need to equip 30 per cent of homes with solar or wind generation, which you need to store.

"But then the grid needs to be able to give the signal to the user to let them know when to use the power they have accumulated. So if, for example, there is a peak in production at the grid scale level the grid operator may want to shave this peak because it may not have enough capacity to supply at, say, 6 pm. So the grid operator will want to discharge the batteries to shave the peaks and needs to be able to give this signal to the user without any manual intervention."

Grid operators that have invested in advanced distribution management and control systems have, according to Godemel, managed to defer investment in centralised generation. And with this deferment or cancellation of what is usually gas fired generation, they have also made a positive impact in cutting carbon emissions.

He added: "They have also recognised 1 per cent less losses in their network. And when this is transferred into CO_2 savings, especially when the power is produced with gas or coal, the saving is huge."

Godemel also pointed out that the use of technologies, which enable net zero office buildings that are automatically connected to the local the grid, can have a return on investment of less than five years. He noted that industries are also investing in local generation and digital automation systems to provide 10-15 per cent of their energy needs, thereby cutting CO_2 emissions and costs.

Importantly, Godemel, stresses that all of these grid balancing and automation technologies exist today. What is missing, he says, is legislation on the demand side that incentivises prosumers.

"Part of this is to do with how we price energy; it's about policy and financial incentives," he said. "Since the Ukraine war, the price of energy has skyrocketed. The price of energy in Europe is simply linked to the price of gas with no consideration of renewables. Legislation needs to inject an incentive for prosumers to use [renewable] energy at the time when it is abundant. If I charge my car at night it is a bit cheaper but it is completely independent of the abundant production of renewables during the day. It should not be. So prosumers should be given financial incentives in their energy bill.

"There also needs to be a mechanism at grid level that drives investment in digitalisation. Digital investments need to be taken more seriously and must be more central to the equation."

Godemel says that to make all of this happen calls for tripartite collaboration between utilities, groups of users, and technology vendors. "Of the utilities, DSOs are the centrepiece," he noted. "You don't necessary need all three parties at the same time to implement solutions. For example if you want to implement load shaving, you need the involvement of the demand side. For load balancing, it's between technology vendors and utilities. And reflection of what are the best solutions often come from working groups and the experience from all three parties."

In terms of what needs to happen next, Godemel believes that ideally there should be a big boom in prosumers. "It would help the entire situation very quickly because these are typically multiple companies so the burden is not placed on one or two companies and it would be at large scale." He stresses, however, that any near-term boom in prosumers is unlikely, as policies and incentives must first be changed. "It takes time to convince people; we've seen this with EVs."

He therefore argues that while prosumers would have the biggest impact, the most implementable solution today is investment in digitalisation at the distribution grid level.

Godemel concluded: "We need distribution management systems connected to the data of smart meters in all countries, as well as automation at the secondary distribution layer, i.e. between the medium- and low-voltage. Today there is very little automation here. And of course we need to put green products into our substations. For example we can get rid of SF_6 gas in switchgear.

"There are a few things that we can do fairly quickly, and the European Commission is working to support solutions like these that can quickly help accelerate the transition. I believe the energy crisis will accelerate all the drivers behind a decarbonised electricity system, and hope this gas crisis can be somehow translated into an energy revolution."

A softer approach to tackling the energy crisis

The ongoing energy crisis is affecting transmission system operators (TSOs) across Europe and particularly Germany, which faces the challenge of transmitting power from North to South. **Junior Isles** hears how grid operators can at least avoid a potential blackout this winter with the help of software to boost grid capacity.

Arguably, there has been insufficient progress in enabling Europe's electricity grids to cope with the challenges presented by the energy transition. Germany is a classic case in point. Having taken the decision to phase-out nuclear in reaction to the Fukushima disaster, the country has embarked on replacing this lost generating capacity by installing huge amounts of offshore wind turbines in the North Sea.

While these turbines have been successfully connected to the onshore grid via DC links, progress has been slow in building the onshore lines needed to transmit this power to the industrial south. The reasons behind Germany's plight are several, the most notable being the difficulty in obtaining permits to build overhead lines and converter stations. But while legislation is crucial here, the increasing amount of renewables also means that millions of new assets must be connected to the grid, as the government incentivises technologies such as rooftop solar and batteries and the purchase of electric vehicles (EVs).

All of this, combined with the impacts of Russia's war in Ukraine, has raised concerns over the security of electricity supply across the country.

Siemens AG believes that the only way to match the hosting capacity of the power grid with the growth in distributed energy resources is by increasingly utilising current and future software solutions in addition to hardware enhancements.

Explaining the challenges, Frank Grunert, Head of Grid Control, Siemens AG, said: "There is a lot of generation coming onto the low voltage grid. There has been a massive increase in renewables, which is being accelerated as we try to move away from fossil fuels due to the war in Ukraine. Gas prices have, for example, driven the growth of heat pumps – if you look at heat pump manufacturers, their order books are full. But if there are a lot of consumers using heat pumps and EVs, this puts a lot of stress on the grid. This bi-directional power flow has to be managed."

Grunert believes software can help address many of the problems facing transmission system operators (TSOs) and distribution system operators (DSOs). He noted: "When grids are not balanced correctly, there's a risk of an unplanned outage. To avoid this, a grid operator needs to have transparency on the grid early enough to see when grid stability is at risk so they can take measures to prevent that blackout or in the worst case do controlled load-shedding and warn consumers well in advance."

Greater transparency is particularly needed on the low voltage grid, to address problems "at the root". According to Grunert if simulations can be carried out at this level, grid enforcement measures can be undertaken in specific areas of the network to avoid incidents at the medium and high voltage level. He notes that here, software can play a major role in providing grid operators with the necessary transparency.

Hardware, he adds, can also play a major role. For example, several countries have either completed or are well advanced in their smart meter rollout programmes. Grunert noted, however, that smart meter deployment has been disappointing in Germany. In October Economy Minister Robert Habeck said that installations will be accelerated, with the government pledging to remove legal uncertainties and bureaucratic hurdles through a package of measures that would accelerate and simplify their installation.

"Germany is currently still lagging behind when it comes to rolling out smart meters, which would help to get the data for better transparency on the low voltage grid," Grunert commented.

Software can also increase security on high voltage transmission lines. One such solution is dynamic line rating (DLR), where software is used to temporarily increase transmission line capacity when needed.

Grunert explained: "Transmission lines are designed to have thermal limits, which limit transmission capacity. These limits are based on worst-case weather assumptions, e.g. when it is hot or there is no wind. Connecting grid operation with weather data would allow these limits to be changed for certain network areas or sections of the overhead line, where there is a cooler climate or temperature, or where there is greater wind chill. Then we can temporarily increase transmission capacity dynamically – up to 30 per cent."

German TSO TransnetBW recently introduced such a system, which it says enables overhead lines to transport up to 50 per cent more electricity when it is windy and in cooler ambient temperatures.

Grunert noted: "This is done just through software. This is why software is such a big enabler of the energy transition, because it limits capital expenditure. You can increase the capacity of grids without installing more copper."

Another important area where software comes into play is for protection concepts in substations. Protection devices in networks are set to default values for voltage and current. If there is an overcurrent, for example, this is recognised by the protection device, which then trips the respective network or grid section. Grunert explained that these default values can be "manipulated" to increase power throughput.

He said: "We can use flexible values depending on the actual situation in the specific grid area. This also allows us to increase the available capacity of the grid."

The dynamic stability of the grid can also be improved using software solutions. Trend analysis programmes can make forward-looking assessments of the dynamic stability of the grid and offer grid operators options on how to keep the grid stable.

Grunert also stresses the importance of changing human behaviour in relieving pressure on the grid and noted the increasing use of apps.

"It's important to help the population recognise when there is a tense situation for grid stability so they can change their behaviour. For example, not everyone needs to switch on their washing machine or charge their EVs at the same time. For the first time, Germany recently rolled out an app that will help balance supply and consumption."

The "StromGedacht" app from TransnetBW allows private households in Baden-Württemberg to actively contribute to system stability by making suggestions as to how the user can effectively relieve the grid by shifting electricity consumption over time.

Such software tools are important for the immediate challenges but going forward, grid operators are looking at how to better plan the grids of the future in order to accelerate the energy transition. And again, software has a huge part to play in the form of creating digital twins of networks.

"Digital twins are really important," said Grunert. "If you want to better plan your grid and make better use of investment, it helps to have a digital representation of your grid. We are at the start of the curve here… but it will allow you to simulate and analyse a lot of situations on the grid and what it means to all stakeholders connected to it. They could also help you to recognise any reinforcement you might want to undertake to strengthen the grid."

Grunert: Software can also increase security on high voltage transmission lines

While some utilities and grid operators make better use of these technologies than others, Grunert notes that the speed of change has increased dramatically in recent years. "Apps that inform the public about the grid status are a good example that shows they are truly changing and accelerating their efforts significantly," he said. "Deploying new software requires a more agile mindset. And I see that our customers are becoming more agile in their approaches and processes."

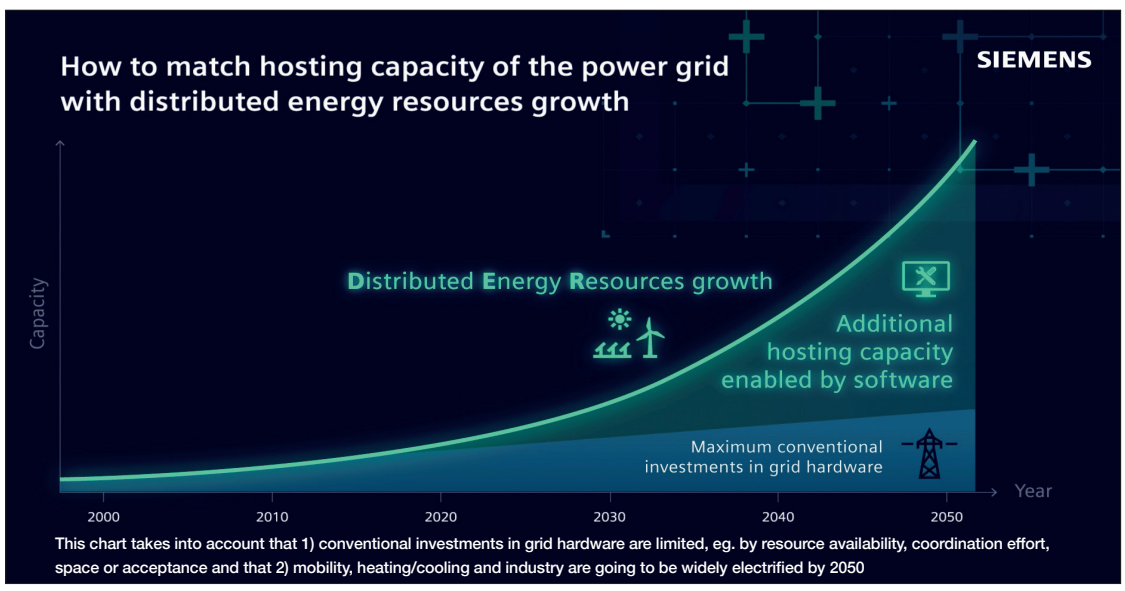
Grunert said, however, that while utilities and vendors are becoming more agile, the same is required of regulators to respond to not only the needs of today but also those of tomorrow. "They need to support the grid operators in their agile approach."

"Today's modern software has changed. We are not looking at monolithic systems anymore, which are highly customised to manage grids. Today's systems are more modular, open and flexible, allowing utilities to create their own software solution landscape from various vendors to deal with the huge amount of assets and data that is coming. This software is usually cloud-native so it can be easily scaled up.

"There are different models for paying for the software but we need opex-based remuneration models for software licences. It's about capex versus opex. Most of the remuneration models today are capex-based and do not support modern cloud-native software. The [German] regulator needs to allow opex-based remuneration at least for software because it is the biggest enabler for the energy transition."

He concluded: "There is a gap between what we can do, with conventional hardware, and what we need to do in order to achieve net zero. The only way to close the gap is with software."

The only way to close the gap is with software



Giving biogas a boost

Biogas has an important role to play in reducing fossil fuel dependence but more needs to be done to ramp-up production of this renewable gas. Vertus Energy's **Benjamin Howard** shares his view on the potential of biogas and describes a technology that can improve production efficiency.

The world's consumption of energy has seen a significant upshot since the 1980s, owing to a rapid wave of industrialisations. Fossil fuels have largely been supplied to satisfy this growing demand for energy. As recent as 2018, about 88 per cent of the world's total energy demand was being met by fossil fuels. With carbon emissions growing and the finite supply of fossil fuels decreasing, viable renewable alternatives are needed more than ever.

In this quest for energy security and push towards low emission energy, renewable natural gas (RNG), in the form of biogas/biomethane (CH_4), is an efficient, clean and cost effective solution to help the world wean itself off fossil fuels for energy supplies.

According to the European Biogas Association, biogas or biomethane form the bedrock to achieve carbon neutrality by 2050 and achieve energy security. However, further investments in biogas innovations are imperative to make biogas production faster and increase yields.

Biogas or biomethane is produced through the process of anaerobic digestion (AD), where biodegradable material is broken down by microorganisms in the absence of oxygen. This creates RNG, which through technological advancement, has the potential to generate renewable energy on a global scale.

There are four stages to produce biogas within the anaerobic digestion tank:

1. Hydrolosis: organic polymers like carbohydrates are broken down into simple sugars
2. Acidogensis: bacteria called acidogenic bacteria convert the simple sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids
3. Acetogenisis: bacteria called acetogenic bacteria convert the organic acids into acetic acid, carbon dioxide (CO_2), and hydrogen
4. Methanogensis: single-celled organisms called methanogens convert the intermediate products produced in the preceding stages into biogas (primarily biomethane and CO_2).

Using biogas has a number of benefits. The production process of biogas means that it offers an entirely practical solution to dispose of farm and livestock waste. Using biodigesters to control the rate of decomposition of agricultural by-products can produce a viable amount of RNG to realistically replace fossil fuel energy. The process uses emissions that would have occurred naturally in the environment due to decomposition of organic matter – albeit there is a need for the production process to be made more efficient.

Another advantage is the low cost of producing biogas. Investment in biogas is relatively cost effective, as anaerobic digesters can be easily fitted in farms and plants on an industrial scale. This contrasts with other renewable sources being explored, such as hydrogen, the implementation of which is expensive when considering the cost of distribution, production, and storage. Moreover, biogas (once upgraded into biomethane) is a direct replacement for fossil fuels and can be used in the existing energy pipes, so adoption can be quicker as well as cheaper.

Many westernised countries like the UK and US have the infrastructure already in place to support greater adoption of renewable energy sources – they are steps ahead of other markets. In Europe alone, there are 24 300 biogas plants, 10 000 of which are just in Germany. However, there are some key factors standing in the way of large-scale adoption.

There are various hurdles to widespread implementation and adoption of biogas technology, which are region-specific and unique to the economy and its propensity towards renewable energy.

Differences in government regulation, energy policy, attitudes towards climate change, and economics can each present significant barriers to widespread adoption of biogas as a transition fuel. The journey to defossilisation is paved with collaborative effort in policy making and investment in shared technological resources, since anaerobic digestion and biogas production requires an immense amount of support.

With respect to attitudes towards climate change and renewable energy, Uruguay, for instance, is leaps and bounds ahead with nearly 98 per cent of its energy requirements being fulfilled by renewable sources – a feat that is not easily achieved or replicated in other parts of the world.

The European Union Commission's attempt to strive for a pan-European agreement to invest in biogas and biomethane technology is an example of steps being taken towards collaboration in policy and governments. This can be further bolstered by governing institutions well-versed in the adoption of renewables, such as Germany, offering support to countries that would benefit from this insight.

For biogas to be an all-encompassing and attractive offering, it is imperative that we show investment in RNG to be profitable as well as sustainable. Ramping up biogas production consists of a combination of factors ranging from funding to government support. Careful attention and collaboration amongst all stakeholders is necessary for wide scale implementation. Recent funding by BP into biogas technology is testament to the role different actors can play.

Further investments in biogas innovations are imperative to make biogas production faster and increase yields. To this end, Vertus Energy has developed technology that allows AD plants to process waste three times faster in the same sized tank while delivering 60 per cent more energy, using a retrofitted bio-catalytic platform. BRIO is a small but powerful unit that is placed inside the anaerobic digester. The unit provides electrical stimulation to the bacteria in the tank, accelerating molecular activity that breaks down waste and converts the resulting gases into biomethane.

This enhanced environment enables additional molecular pathways to activate, meaning more CO_2 can convert into methane, increasing the Methane Production Rate and the Methane Conversion Rate. This makes use of existing but unutilised molecular pathways within AD tanks by electrically spurring the bacteria into action, which accelerates the process.

Biogas can be further turned into biomethane (a purer and more effective form of biogas) – by removing carbon dioxide or in some cases, hydrogen sulphide – which is very valuable as a direct replacement of fossil natural gas. Since biomethane is derived from the biological process of breaking down waste, it is renewable, as opposed to fossil derived methane, which is the result of fossil and organic matter undergoing years of compression and degradation. This means more RNG in the form of biomethane is available for energy firms to purchase and the result is a greener energy mix. Using biomethane decreases the reliance on fossil fuels to plug energy gaps in the national grid.

So does biogas technology set us up for the future? Climate technology that champions renewable energy has never been riper with interest and investment than in the past few years. There is a sense of urgency for biogas penetration to increase from 40 to 60 per cent, which is possible only through cultural and political shifts by governments and investors alike. In developing countries, biogas can help fulfil the energy demand, owing to the relatively low implementation costs and having the potential for yields matching fossil fuels.

To bring about this shift and ensure that the potential of biogas energy is being recognised, we must make use of the technology that is already available to us. A way to do this is to increase the productivity of smaller scale units that can be engineered offsite and brought in when the need arises. Vertus' BRIO solution is a great example of this; it is a compact unit about the size of a shipping container, which can be retrofitted into existing ADs.

Howard's aim is to retrofit BRIO units into every anaerobic digester

In November Vertus announced that it is partnering with Biogest to demonstrate the BRIO solution at a commercial scale in Europe. The aim is to retrofit BRIO technology into every anaerobic digester to help Europe maximise its existing plant production, which when achieved could meet 66 per cent of the region's 2030 targets.

The pilot will begin in 2023 within the testing facility and move to the demonstration unit in 2024. This demonstration unit is the start of the BRIO commercialisation, showing investors and other potential partners that BRIO can be implemented at commercial scale.

Such developments are the first step in achieving the transition to permanent renewable energy. Once commercially enabled, Europe will have an energy option that is domestically sourced and less vulnerable to price changes based on international politics and environmental change. For households, this could mean cheaper energy bills that are less likely to fluctuate. With the ongoing energy crisis in Europe, this is a significant step forward for the implementation of more renewables in the energy mix and the decarbonisation of our energy matrix.

The scale of change needed, however, requires the participation of governments and the private sector. Governing institutions can step in to deal with regulatory issues and collaborate on policy that encourages the move towards defossilisation, starting with existing AD and biogas technology. The role of private actors is to make this not only sustainable, but commercially attractive through investing in technologies that help scale biogas production. The key to unlocking biogas' role in the reduction of fossil fuel reliance is an exercise in collaboration, propelled by the need to achieve secure, clean and sustainable energy for the future.

Benjamin Howard is co-founder of Vertus Energy.

In Europe alone, there are 24 300 biogas plants, 10 000 of which are in Germany

Junior Isles

On track and picking up speed

Last year proved to be a memorable one for that magic molecule, hydrogen. More specifically, last month marked some milestone moments in the long, arduous journey that might one day see hydrogen become the single most important element in the global energy system.

In mid-December scientists at Lawrence Livermore National Laboratory in California, USA, achieved 'ignition', a fusion reaction that produced more energy than it took to create.

Nuclear fusion, the process that powers the sun, has long been the holy grail of energy. Replicating fusion on Earth would allow the near limitless generation of zero carbon energy but has been deemed by some as the stuff of science fiction. For decades scientists have conducted numerous experiments, successfully heating hydrogen isotopes – normally deuterium and tritium – to such extreme temperatures that the atomic nuclei fuse, releasing helium and energy in the form of neutrons. But such experiments have consumed far more energy than released – until last month's breakthrough.

It is a hugely significant milestone and proponents argue it paves the way for commercial scale power plants within the next couple of decades or sooner. But there is still a long way to go, with significant challenges to overcome.

For now, using hydrogen in its elemental form as an energy vector is a lot less sci-fi than fusion. Hydrogen is seen as essential to decarbonise sectors that cannot be electrified, e.g. aviation, maritime, and high-heat manufacturing.

To meet decarbonisation targets of the Paris Agreement, hydrogen uptake would need to triple to meet 15 per cent of energy demand by mid-century. In a report issued last summer, DNV predicted the amount of hydrogen in the energy mix will be only 0.5 per cent in 2030 and 5 per cent in 2050. It seems a very small share but with the pace of development it would be no surprise if such predictions are surpassed, at least in Europe where DNV predicts hydrogen is set to take 11 per cent of the energy mix by 2050.

Last month saw several noteworthy announcements, which certainly indicate there is every likelihood that Europe's hydrogen train may well reach its destination ahead of schedule.

In early December, Spain, Portugal and France said they want to complete a €2.5 billion underwater green hydrogen pipeline from Barcelona to Marseille by 2030. It will be part of the wider H2Med project – the first green corridor to connect the Iberian Peninsula with the rest of Europe – which will interconnect Portugal and Spain with France and have a total cost of around €2850 million. H2Med will comprise two routes: one that will interconnect Portugal with Spain (Celorico-Zamora) and the new submarine hydrogen pipeline between Barcelona and Marseille (BarMar) to link the Iberian Peninsula with France.

Around the same time, Cepsa announced plans to build Europe's largest green hydrogen project in Andalusia with an investment of €3 billion. Known as the Andalusian Green Hydrogen Valley, it will involve the start-up of two new electrolyser plants, with a capacity of 2 GW and a production of up to 300 000 tons of green hydrogen. These will be located at Cepsa's energy parks in Campo de Gibraltar (Cadiz) and Palos de la Frontera (Huelva). In addition, the project will be accompanied by an additional investment of €2 billion for the development of a 3 GW wind and solar energy project portfolio to generate renewable electricity.

Meanwhile, Repsol is leading the Shyne project, in which it plans to invest more than €2.2 billion, with targets to install 500 MW by 2025 and 2 GW by 2030. The project will also connect major regional hydrogen initiatives that are already underway, such as the Basque Hydrogen Corridor (BH2C), the Hydrogen Valley of Catalonia and the Hydrogen Valley of the Region of Murcia.

Spain has a total of 80 projects – mainly focused on the southern, Cantabrian and Mediterranean coasts. These areas are more industrialised and therefore have more possibilities for using hydrogen. Most of the projects are aimed at industrial applications for renewable hydrogen.

It is a portfolio of projects that calls for the development of more than 15 GW of installed capacity of electrolysers, demonstrating the country's strong interest in green hydrogen. The government's push for renewable hydrogen is part of a roadmap that foresees 4 GW of installed electrolyser capacity by 2030.

According to the Ministry for Ecological Transition and the Demographic Challenge, this appetite gives "a clear vision that the objective of 4 GW at the end of this decade will be reached and surpassed". The government is therefore working towards revising the National Integrated Energy and Climate Plan to raise the renewable hydrogen target to 2030.

The other big news last month was Germany's plan to develop an 1800 km hydrogen energy pipeline network by 2027 with state participation. According to an economy ministry draft strategy paper seen by *Reuters*, the creation of a hydrogen network company was needed to build a system that was both fit for purpose and affordable. The government also envisages Germany doubling its electrolyser capacity to 10 GW by 2030, the paper said.

In a separate paper, Germany's National Hydrogen Council presented a roadmap with actions that need to be taken in order to ensure enough storage capacity for hydrogen and support the transition from natural gas to a hydrogen economy. In the paper, the Council underscores the need for political support to promote investments in hydrogen storage as demand in Europe's largest economy is expected to exceed 5 TWh by 2030 and then increase significantly.

These announcements all came just ahead of a statement that was expected from the European Commission, which will set the rules around the requirements for green hydrogen.

'Additionality' rules were expected to be published last month in a move aimed at avoiding "the cannibalisation" of existing wind and solar generation, ensuring that renewable hydrogen is produced at times and at places where renewable electricity is available. According to a draft document published by *EURACTIVE*, there should be a quarterly correlation between renewable generation and hydrogen production and a geographical correlation in terms of being located in the same electricity bidding zone.

German Social Democrat Jens Geier, who is the European Parliament's lead negotiator on parts of the hydrogen and gas package, told reporters in Berlin that the new draft of the regulations is "the best I have seen so far in terms of content".

The Commission is also believed to be studying the establishment of scenarios in which hydrogen production from fossil fuels can be considered "fully renewable". The regulation that Brussels is working on will establish rules to qualify the production of renewable liquid and gaseous fuels of non-biological origin, as well as the resulting fuel, as fully renewable until December 31, 2026. This four-year transition period is designed to offer room for the development of technologies that allow a rapid ramp-up of hydrogen production.

With the war in Ukraine and soaring energy prices, last year was a rollercoaster ride for the energy industry but the green energy train has not been derailed. If anything it is picking up speed, with hydrogen now a real part of the journey.

Cartoon: jemsoar.com